07-19-05

AF/1733 #

PTO/SB/21 (09-04)
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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission

Application Number	09/588,407
Filing Date	June 6, 2000
First Named Inventor	Richard Blackmore
Art Unit	1733
Examiner Name	Steven P. Maki
Attorney Docket Number	240-P-028

ENCLOSURES *(Check all that apply)*

- [✓] Fee Transmittal Form
- [✓] Fee Attached
- [ ] Amendment/Reply
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
- [ ] Certified Copy of Priority Document(s)
- [ ] Reply to Missing Parts/ Incomplete Application
  - [ ] Reply to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition
- [ ] Petition to Convert to a Provisional Application
- [ ] Power of Attorney, Revocation Change of Correspondence Address
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s) _____
  - [ ] Landscape Table on CD
- [ ] After Allowance Communication to TC
- [ ] Appeal Communication to Board of Appeals and Interferences
- [✓] Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- [ ] Proprietary Information
- [ ] Status Letter
- [ ] Other Enclosure(s) (please Identify below):

Remarks

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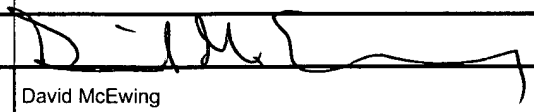
Signature			
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Date	~~July 15, 2005~~ July 17, 2005	Reg. No.	37,026

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Effective on 12/08/2004.
Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).

FEE TRANSMITTAL
For FY 2005

☑ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 250.00

Complete if Known	
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First Named Inventor	Richard Blackmore
Examiner Name	Steven P. Maki
Art Unit	1733
Attorney Docket No.	240-P-028

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FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

	FILING FEES		SEARCH FEES		EXAMINATION FEES		
		Small Entity		Small Entity		Small Entity	
Application Type	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fees Paid ($)
Utility	300	150	500	250	200	100	
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	Fee ($)	Small Entity Fee ($)
Each claim over 20 (including Reissues)	50	25
Each independent claim over 3 (including Reissues)	200	100
Multiple dependent claims	360	180

Total Claims	Extra Claims	Fee ($)	Fee Paid ($)
_____ - 20 or HP =	_____	x _____	= _____

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims	Extra Claims	Fee ($)	Fee Paid ($)
_____ - 3 or HP =	_____	x _____	= _____

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims	
Fee ($)	Fee Paid ($)
_____	_____

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee ($)	Fee Paid ($)
_____ - 100 =	_____	/ 50 = _____ (round up to a whole number)	x _____	= _____

4. OTHER FEE(S)

	Fees Paid ($)
Non-English Specification, $130 fee (no small entity discount)	
Other (e.g., late filing surcharge): Appeal Brief Filing Fee	$250.00

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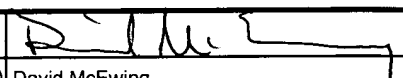
Signature		Registration No. (Attorney/Agent) 37,026	Telephone 713-514-0137
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant:	§	
Richard Blackmore et al.	§	Group Art Unit: 1733
	§	
Serial No. 09/588,407	§	Examiner: Steven P. Maki
	§	
Filed: June 6, 2000	§	Atty. Dkt. No.: 240-P-028
	§	
Confirmation No. 9445	§	

For: Inflatable Heating Device

APPELLANT'S APPEAL BRIEF

Honorable Commissioner of Patents and Trademarks
Alexandria, Virginia

SIR:

This paper is presented as the Appellant's Appeal Brief in compliance with 37 CFR §41.37. The Appellant filed notice of appeal and payment of fee in accordance with 37 CFR §41.31 and §41.37 on May 17, 2005. The required fee due with this Appeal Brief is being paid with the required forms attached hereto.

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TABLE OF CONTENTS

Real Party in Interest	3
Related Appeals and Interferences	3
Status of Claims	3
Status of Amendments	3
Summary of Claimed Subject Matter	4
Grounds of Rejection To Be Reviewed On Appeal	8
Issue 1 *Whether Claim 26 particularly points out and distinctively claims the subject matter which the Appellant regards as the invention.*	11
Issue 2 *Whether Claim 26 contains subject matter which was not described in the specification.*	18
Issue 3 *Whether the Examiner has provided objective evidence of obviousness for Claims 12 & 26.*	24
Issue 4 *Whether the combination of Japan '334 and Hollingsworth is inoperable and thereby teaches away.*	35
Issue 5 *Whether the Examiner has provided objective evidence of obviousness of Claim 28.*	41
Issue 6 *Whether the Examiner has provided objective evidence of obviousness of Claims 14 – 16.*	43
Issue 7 *Whether the Examiner has provided objective evidence of of obviousness of Claims 20 and 22.*	49
Conclusion	52
Claims Appendix	53
Appendix of Evidence	

REAL PARTY IN INTEREST

The real party in interest in this appeal is Verline Inc. The inventors, Richard Blackmore and William Lepola, assigned ownership to Interlaminar Heat Cure, Inc., by document executed June 16, 2000 and recorded in the Assignment Division on December 27, 2000. Intralaminer Heat Cure, Inc. assigned ownership to Verline Inc. by document executed July 1, 2003, and recorded at Reel 015778 Frame 0360.

RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences that may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

STATUS OF CLAIMS

There are a total of 52 claims in the instant application. Of these, 8 have been withdrawn and 32 have been cancelled. Two claims have been allowed. Ten claims are being appealed.

Specifically, the following claims have been canceled: 1 through 6, 17, 21, 29 through 52. The following claims have been withdrawn: 7 through 11, 23 through 25. The following ten (10) claims, identified by claim number, are being appealed: Claim 12, 13, 14, 15, 16, 20, 22, 26, 27 and 28.

STATUS OF AMENDMENTS

The Appellant filed an amendment after Final Rejection on May 3, 2005. The Examiner, by action mailed May 23, 2005, entered the amendment.

SUMMARY OF CLAIMED SUBJECT MATTER

The subject matter of the 10 claims on appeal comprise an apparatus, a method and a system for in-situ repair of conduit utilizing an inflatable bladder resistively heated by electric current running through carbon or graphite fibers or filaments embedded in the bladder.

Claim 12, for which claims 13-16 are dependant claims, is for an apparatus for curing pre-preg repair material supporting a heat curable resin for in-situ repair of conduit (pg. 10, line 21 thru pg.11, line 12). The apparatus comprises:

An elastomeric composite (pg. 7, line 10, and Figures 2 and 3, item 205) having a first and second end and containing a carbon or graphite fiber or filament heating element (pg. 7, line 25 and pg. 8, line 1, and Figures 1 and 4, item 201) disposed within a thermoset resin matrix (pg. 7 lines 23 thru 28, and Figure 1 and 4, item 202).

There is a first end piece (Figure 2, item 6) attached to the first end of the composite containing an air port and a vacuum port (Figure 3, item 7 & 10) and at least one electrical cable port (Figure 3, item 11) to convey electric current to the heating element (pg. 9, lines 3 thru 10).

There is a second end piece (Figure 2, item 8) attached to the second end of the composite. The combined first end piece, the composite and the second end piece form a generally hollow inflation chamber (pg. 10, line 29 and pg. 11, line 4).

The subject matter of Claim 20 comprises a method for repairing a damaged section of a conduit (pg. 4, line 28, pg. 10, line 21 thru pg.11, line 12 and specifically line 10). The method comprises:

Providing an elastomeric composite (pg. 7, line 10, Figure 2, item 205) having a first end and a second end with a carbon or graphite fiber or

filament heating element (Figure 4, item 201) within a thermoset resin matrix (Figures 1 and 6 and Figure 4, item 202) and attaching a first and second end piece (Figures 2, item 6 & 8 and Figure 3, item 6 & 8) thereby forming a heating/inflation module (pg. 9, lines 2 thru 10, Figure 3, item 210).

The next method steps are removably attaching a pre-preg (pg. 10, lines 1 thru 2) to the outer surface of the composite where the pre-preg includes a structural fiber matrix supporting a heat curable resin and positioning the heating/inflation module with the attached pre-preg (pg. 9, line 29 thru pg. 10, line 5, Figure 3, item 3) in the conduit at the damaged location (Figures 3, item 1 and Figure 8, item 1, and pg. 10, lines 19 thru 20).

The method steps then provide for inflating the heating/inflation module to a predetermined air pressure to expand the composite and press the attached pre-preg against the inside of the conduit (pg. 10 line 27 thru pg. 11, line 2).

The next step is curing the resin of the pre-preg by causing an electric current to flow through the heating element to a predetermined temperature and then deflating the heating/inflation module and removing it from the conduit (pg. 11, lines 7 thru 10).

Claim 22 is for a system for in-situ repair of conduit (pg. 4, line 28, pg. 10 thru pg. 5, line11).

The system includes an elastomeric composite (pg. 7, line 14) having a first end and second end with a carbon or graphite fiber or filament heating element (pg. 7, line 25 and pg. 8, line 1) within a thermoset resin matrix (pg. 7 lines 23 thru 28), and a first end piece (Figure 3 & 8, item 6 attached to the first composite end and having an air port (Figure 3 & 8, item 7) for communication with a compressed air source and a vacuum

port (Figure 3 & 8, item 10) for communication with a vacuum supply source and at least one electrical cable (Figure 3 & 8, item 11) to convey electric current to the heating element (pg. 9, lines 3 thru 11).

The system also includes a second end piece (Figure 3 & 8, item 8) attached to the second end of the composite with the first end piece, second end piece and the composite forming an inflation chamber (pg. 9, lines 3 thru 11, and Figures 3 and 8, item 210).

The remaining element of the system is a pre-preg (Figures 3 & 8, item 3) removably attached to an outer surface of the composite (Figure 3 & 8, item 205), the pre-preg including a structural fiber matrix supporting a heat curable resin (pg. 9, line 29 thru pg. 10, line 2).

Claim 26, for which claims 27 and 28 are dependant claims, is for an inflatable heating device (pg. 4 lines 6 thru 11, Figures 3 and 8, item 210) having a generally cylindrical body (pg. 7, lines 12 thru 14) for internal in-situ repair of pipe shaped objects (pg. 8, line 30 thru pg. 9, line 1, Figures 3 and 8, item 1). The device comprises:

An elastomeric seamless composite closed body with at least one layer of a flexible elastomeric material having a first inner surface and second outer surface (Figure 1 & 6, items 202 & 201, and pg. 8, lines 20 thru 23). There is also a plurality of electrically conductive carbon or graphite fibers or filaments located substantially within the cylindrically shaped body between the first inner surface and second outer surface (Figures 1 and 4, items 201 & 202), at least one electrically conductive cable port (Figure 4, item 11) connecting the electrically conductive fibers and at least one air port for inflation and deflation of the closed body (pg. 9, lines 3 thru 11, Figure 4, items 7 & 10).

The inflatable heating device may also comprise components to monitor heat of the composite body and to control resistive heating (pg.

11, lines 13 thru 15).

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Although there are a number of topics to be discussed, *all claims subject of appeal* have been rejected under 35 U.S.C. §103(a) as being unpatentable over Japan '334 (JP 2-150334) in view of Japan '161 (JP 6-234161) or Japan '323 (JP 2-158323) and in view of Hollingsworth (US 5266137) and optionally further in view of at least one additional reference. *Stripped to its core, this appeal argues that the Examiner is improperly attempting to combine Hollingsworth to the primary reference, Japan '334.*

The Examiner admits "the subject matter of the non-metallic electrically conductive fibers comprising 'carbon fibers, graphite fibers, carbon filaments or graphite filaments' *requires the use of Hollingsworth* and was addressed in paragraph 11 of the final office action; Japan 334 teaching the use of non-metallic electrically conductive fibers for resistive heating of an inflatable heating device and Hollingsworth suggesting the use of carbon fibers as resistive heating elements."

The Appellant also argues throughout this brief that the Examiner has failed to establish a prima facie case of obviousness under section 103 by having failed to provide any objective evidence of a motivation or suggestion to combine the references. The Appellant argues that the Examiner has engaged in impermissible hindsight reconstruction of the claimed invention.

ISSUE No. 1

Whether independent claim 26 and dependant claims 27 & 28 have been improperly rejected under 35 U.S.C. 112, second paragraph, as being *indefinite for failing to particularly point out and distinctly claim the subject matter which the Appellant regards as the invention.* Specifically, the Examiner asserts (i) it is unclear where the ports are located, (ii) the description of at least one port for inflation and deflation of the seamless closed body is confusing and (iii) that if the closed body has an air port extending through the cylindrical shape, then the body is no longer closed.

ISSUE No. 2

Whether independent claim 26 and dependant claims 27 & 28 have been improperly rejected under 35 U.S.C. 112, first paragraph as *failing to comply with the written description requirement*. Specifically, the Examiner asserts the claim 26 contains subject matter, i.e., seamless closed body, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, as of the time the application was filed, had possession of the claimed invention. The Examiner further asserts that the disclosed composite is not a seamless closed body since it purportedly has open ends claimed to be shown in Figure 4 of the disclosure.

ISSUE No. 3

Whether the Examiner has met his burden to provide objective evidence to reject independent claims 12 and 26, as well as dependant claims 13 and 27, under 35 U.S.C. §103(a) as being unpatentable over Japan '334 (JP 2-150334) in view of Japan '161 (JP 6-234161) or Japan '323 (JP 2-158323) *and in view of Hollingsworth* (US 5266137) and optionally further in view of Wood et al (US 5706861) and Guenthner et al (US 5216085).

ISSUE No. 4

Whether the combination urged by the Examiner is permissible. Specifically *whether the intended function of Japan '334 or Hollingsworth is destroyed by the combination and thereby the Hollingsworth reference teaches away from the combination*.

ISSUE No. 5

Whether the Examiner has met his burden to provide objective evidence to reject claim 28 under 35 U.S.C. §103(a) as being unpatentable over Japan '334 (JP 2-150334) in view of Japan '161 (JP 6-234161) or Japan '323 (JP 2-158323) and in view of Hollingsworth (US

5266137) and optionally further in view of Renaud (US 4861634).

ISSUE No. 6

Whether the Examiner has met his burden to provide objective evidence to reject claims 14-16 under 35 U.S.C. §103(a) as being unpatentable over Japan '334 (JP 2-150334) in view of Japan '161 (JP 6-234161) or Japan '323 (JP 2-158323) and in view of Hollingsworth (US 5266137) and optionally further in view of Baker et al (US 4191383) and optionally Rankin (US 1362351) and Renaud (US 4861634).

ISSUE No. 7

Whether the Examiner has met his burden to provide objective evidence to reject claims 20 and 22 under 35 U.S.C. §103(a) as being unpatentable over Japan '334 (JP 2-150334) in view of Japan '161 (JP 6-234161) or Japan '323 (JP 2-158323) and in view of Hollingsworth (US 5266137) and optionally further in view of at least one of Wood et al and Guenthner et al as applied above and further in view of Lippiatt (US 5,199,463).

ARGUMENT

ISSUE No. 1

Whether independent claim 26 and dependant claims 27 and 28 *particularly point out and distinctly claim the subject matter which the Appellant regards as the invention.*

The invention subject of the appealed claims is entitled "Inflatable Heating Device." The Examiner has rejected claims 26 through 28 under § 112, second paragraph, as being indefinite for failing to particularly point out and distinctively claim the subject matter which the Appellant regards as the invention. Specifically, the Examiner asserts it is unclear where the ports are located on the inflatable heating device. The Examiner also asserts the description of at least one port for inflation and deflation of the seamless closed body is confusing. Last, the Examiner states that if the closed body has an air port extending through the cylindrical shape, then the body is no longer closed.

The independent claim 26 reads as follows:

> 26. An inflatable heating device having a generally cylindrical body for internal in-situ repair of pipe shaped objects comprising:
>
> *an elastomeric seamless composite closed body having a generally cylindrical shape* formed of at least one layer of a flexible elastomeric material having a first inner surface and a second outer surface, a plurality of nonmetallic, electrically conductive fibers comprising carbon fibers, graphite fibers, carbon filament or graphite filaments and located substantially throughout the length of the cylindrical shaped body between the first inner surface and second outer surface of the flexible elastomeric material;
>
> at least one electrically conductive cable port connecting the electrically conductive fibers to an electrical power source; and
>
> *at least one air port for inflation and deflation of the closed body.* (emphasis added)

27. (Previously Presented) The inflatable heating device of Claim 26 wherein the generally cylindrical body has an outer diameter sized to allow the second outer surface to contact an inner surface of a repair object to transfer electrical resistive heat energy created by the conductive fibers located between the first inner surface layer and second outer surface layer when energized by the electrical power source and the body is inflated.

28. (Previously Presented) The inflatable heating device of Claim 26 further comprising components to monitor heat of the composite body and to control resistive heating.

At issue is whether the application has adequately disclosed where the ports are located, whether the reference to "at least one port for inflation and deflation of the seamless closed body" is confusing, and lastly, whether the Examiner is correct in asserting that if the closed body has an air port extending through its cylindrical shape, then the body is no longer closed.

The standard for assessing whether a patent claim is sufficiently definite to satisfy the statutory requirement is as follows: "If one skilled in the art would understand the bounds of the claim *when read in light of the specification*, then the claim satisfies section 112 paragraph 2." Miles Labs., Inc. v. Shandon, Inc., 997 F2d 870, 875, 27 USPQ2d 1123, 1126 (Fed. Cir. 1993), Exxon Research and Engineering Company v. US, 265 F3d 1371, 1375, 60 USPQ2d 1272, 1276 (Fed. Cir. 2001). (emphasis added)

It is the Appellant's position that ambiguity, if any, within the text of the claim is readily clarified by the clear text of the specification. A copy of the Appellant's specification is attached as Exhibit A-1 in the Appendix of

Evidence.[1]

First, the Summary of Invention, at page 4, beginning at line 9, describes the invention as follows:

> "The apparatus of the present invention is generally characterized by a heating/inflation module having pressurizable interior and an attached heat curable pre-preg. In particular, an elastomeric seamless composite is provided that includes a heating element disposed within a thermoset resin matrix. The composite is adapted to maintain a consistent temperature profile and an internal air pressure. *A first end piece is attached to a first end of the composite and has an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port for communication with a power supply source*. A second end piece is attached to a second end of the composite."

The above highlighted sentence is the first statement of where the ports are located.

The detailed description of the invention includes a detailed description and illustration of one embodiment of the invention. Referencing the specification at page 9, beginning at line 3:

> "Figures 3-5 show the elastomeric composite 205 integrated into a heater/inflation module 210. *The module 210 includes front and rear end pieces 6, 8 to effectively seal the interior of the composite 205.* Thus the front and rear end pieces 6, 8 are permanently attached to the front and rear ends of the

[1]The specification for the invention is as originally filed. The specification was amended twice, on September 25, 2002 and May 3, 2005. Copies of each amendment are included with Exhibit A-1.

composite 205 and sealed by sealing means 112, 101. *The front end piece 6 includes an air line 7, a vacuum line 10, and one or more electrical cable lines* (not shown) within an electrical conduit 11. These lines 7, 10, 11 respectively provide communication to an air compressor, vacuum supply source and electrical energy source (not shown) used in the in situ repair method described below."

The above highlighted sentence is the second statement of where the ports are located.

Copies of Figures 3, 4 & 5 are included in Exhibit A-2 attached in the Appendix of Evidence. Referencing Figure 3, the air line 7, vacuum line 10 and electrical conduit 11 are clearly shown to be located at the end 6 of the expandable bladder 210.

The location of the ports are clearly explained in the text of the specification and drawings

The claim includes "at least one air port for inflation and deflation of the closed body". The Examiner states this is confusing. However, the sentence of the summary of invention states that "a first end piece is attached to a first end of the composite and has an *air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source* and at least one electrical cable port for communication with a power supply source". The detailed description of the invention includes the text "the front end piece 6 includes *an air line 7, a vacuum line 10*, and one or more electrical cable lines ...". The Appellant believes that a person reasonably skilled in the art would consider it possible that the same port could be used for the input of fluid as well as the exhaust of fluid.

As disclosed in the following excerpt (beginning at page 10, line 21) from the detailed description of the invention, the steps of fluid input and fluid exhaust are separate steps that are not performed concurrently.

"In operation, the heater/inflation module 210 with the attached pre-preg 3 is transported to the damaged section 2 of

> the pipe 1. .... Once the module 210 is in place, an air compressor (not shown) is engaged to direct air into the interior or inflation chamber 102 of the module 210 through its air line 7. The module 210 is brought to a predetermined pressure to expand the composite 205 within the pipe 1. Consequently, the pre-preg is forced against the interior surface of the pipe section 2 and thus conforms to the internal shape of the pipe. .... Once the pre-preg 3 has fully cured against the damaged pipe section 2, the module 210 is deflated by engaging a remote vacuum source (not shown) to draw a vacuum through the vacuum line 10. The module 210 may then by (sic) removed from the repair pipe 1."

There is no basis for confusion.

In regard to the Examiner's statement that if the closed body has an air port extending through the cylindrical shape, then the body is no longer closed, the text of the of the Appellant's disclosure states "the apparatus of the present invention is generally characterized by a heating/inflation module having *pressurizable interior* ... ." It is the Appellant's position that a person skilled in the art would readily understand that a sealed inflatable module or bladder, like a balloon, can have an opening for inflation and exhaust. When the end of the balloon is closed or tied, the interior of the inflated balloon is considered pressurized and sealed.

The quoted text and the referenced figures attached hereto show the specific location of the ports on the heating/inflation module of the invention. They are located at one of the two ends of the closed inflatable cylindrically shaped module or bladder. The air inflatable and deflatable nature of the closed body attached to an air communication component, i.e., ports, would be readily understood by a person possessing ordinary skill in the art.

Therefore the Appellant believes claims 26, 27 and 28 particularly point out and distinctly define the claimed subject matter.

Assuming for argument that there is still an issue of ambiguity in a claim after being read in light of the specification, the claim remains valid if it is "amenable to construction, however difficult that task may be". Stated differently, only if the claim "is insolubly ambiguous, and no narrowing construction can be properly adopted" will the claim be held indefinite. "If the meaning of the claim is discernible, even though the task may be formidable and the conclusion may be one over which reasonable persons will disagree, (the court has) held the claim sufficiently clear to avoid invalidity on indefiniteness grounds." Exxon Research and Engineering Company v. US, 265 F3d 1371, 1375, 60 USPQ2d 1272, 1276 (Fed. Cir. 2001), citing Modine Mfg. Co. v. U.S. Int'l Trade Comm'n, 75 F3d 1545, 1557, 37 USPQ2d 1609, 1617 (Fed. Cir. 1996)

Further, the requirement to *distinctly claim* the invention means that the claim must have a meaning discernible to one of ordinary skill in the art *when construed according to correct principles*. See Metabolite Lab. v. Laboratory Corp., 370 F3d 1354, 1366, 71 USPQ2d 1081, 1089 (Fed. Cir. 2004). Only after a thorough attempt to understand the meaning of a claim has failed to resolve material ambiguities can one conclude that the claim is invalid for indefiniteness, citing All Dental Prodx, LLC v. Advantage Dental Prods., Ind., 309 F3d 774, 780, 64 USPQ2d 1945, 1949 (Fed. Cir. 2002)

Reference is also made to the MPEP which, although not legal authority, does supply useful guidance. MPEP §2173.02 states the essential inquiry pertains to whether the claims set out and circumscribe a particular subject matter with a *reasonable degree* of clarity and particularity. *Definiteness of claim language must be analyzed, not in a vacuum, but in light of:*

(A) *The content of the particular application disclosure*;

(B) The teaching of the prior art; and

(C) The *claim interpretation that would be given by one possessing the ordinary level of skill in the pertinent art at the time the*

invention was made. (emphasis added)

Citing MPEP §2173.05(b), the fact that claim language may not be precise does *not* render the claim indefinite under 35 U.S.C. §112, second paragraph. *Acceptability of the claim language depends on whether one of ordinary skill in the art would understand what is claimed, in light of the specification*.

It is the Appellant's position that claim 26, read with the specification and drawings by a person possessing ordinary skill in the art, contains the requisite clarity. The Examiner's rejection of claims 26, 27 and 28 is without merit. The rejection should be rescinded and the claims allowed to issue.

ISSUE No. 2

Whether claims 26, 27 and 28 contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention.

The Examiner asserts the claim 26 contains subject matter, i.e., seamless closed body, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, as of the time the application was filed, had possession of the claimed invention. The Examiner further asserts that the disclosed composite is not a seamless closed body since it has open ends as he asserts to be shown in Figure 4 of the disclosure. (Figure 4, along with Figures 3 & 5, are attached in Exhibit A of the Appendix.)

The Examiner has merely made an assertion.

The test for compliance with §112 has always required sufficient information to be in the original disclosure to show that the inventor *possessed* the invention at the time of the original filing. Moba B.V. v. Diamond Automation Inc., 325 F3d 1306, 1320, 66 USPQ2d 1429, 1439 (Fed. Cir. 2003).

> "A patent specification must contain an adequate written description. 35 U.S.C. § 112, para. 1 (1994). Whether a specification complies with the written description requirement of § 112, para. 1 is a question of fact that this court reviews for substantial evidence." Moba, 325 F3d at 1319 citing Advanced Display Sys., 212 F3d 1272, 1281, 54 USPQ2d 1673, 1683 (Fed. Cir. 2000).

> "(S)ubstantial evidence is "such relevant evidence from the record taken as a whole as might be accepted by a reasonable mind as adequate to support the finding under review." Princeton Biochemicals V. Beckman Coulter, Inc., 04-1493 (Fed. Cir. 2005) citing Tex. Instruments Inc. v. Cypress

Semiconductor Corp., 90 F.3d 1558, 1563, 39 USPQ2d 1492, 1496 (Fed. Cir. 1996).

"When the scope of a claim has been changed by amendment in such a way as to justify an assertion that it is directed to a different invention than was the original claim, it is proper to inquire whether the newly claimed subject matter was described in the patent application when filed as the invention of the applicant. That is the essence of the so-called `description requirement' of §112, first paragraph." Moba, 325 F3d at 1320 citing In re Wright, 866 F2d 422, 424, 9 USPQ2d 1649, 1651 (Fed. Cir. 1989)

The *possession test requires assessment from the viewpoint of one of skill in the art.* Vas-Cath Inc. v. Mahurkar, 935 F2d 1955, 1563 (Fed. Cir. 1991). The written description requirement does not require the applicant to describe exactly the subject matter claimed, but instead *the description must clearly allow persons of ordinary skill in the art to recognize that he or she invented what is claimed.* Moba B.V. v. Diamond Automation Inc., 325 F3d at 1321, 66 USPQ2d at 1439. (emphasis supplied)

In regard to whether the invention described a seamless closed body, the claimed invention which is at issue states as follows:

26. An inflatable heating device having a generally cylindrical body for internal in-situ repair of pipe shaped objects comprising:

an elastomeric seamless composite closed body having a generally cylindrical shape formed of at least one layer of a flexible elastomeric material having a first inner surface and a second outer surface, a plurality of nonmetallic, electrically conductive fibers comprising carbon fibers, graphite fibers, carbon filament or graphite filaments and located substantially throughout

the length of the cylindrical shaped body between the first inner surface and second outer surface of the flexible elastomeric material;

at least one electrically conductive cable port connecting the electrically conductive fibers to an electrical power source; and

at least one air port for inflation and deflation of the closed body. (emphasis added)

Indeed, the specification specifically recites at page 4, line 9 that:

"The apparatus of the present invention is generally characterized by a heating/inflation module having a *pressurizable interior* and an attached heat curable pre-preg. In particular, an *elastomeric, seamless composite* is provided that includes a heating element disposed within a thermoset resin matrix." (emphasis added.)

Further, the disclosure states at page 7, beginning at line 12:

"The composite 205 is *inflatable* or *elastomeric, seamless*, reinforced with structural braids 201, and for most application *generally cylindrical.*

At page line 9, beginning at line 4:

"The module 210 includes front and rear end pieces 6, 8 to *effectively seal the interior of the composite* 205." (emphasis added.)

The above quoted text of the specification clearly shows that the Appellant was in possession of the invention claiming an elastomeric seamless closed body. *It is the Appellant's position that a person skilled in the relevant art would reasonably find that an object described within the invention specification as "elastomeric", "inflatable", "seamless", "pressurizable interior", is the same object*

defined in the claim as "elastomeric, seamless composite closed body" having "at least one air port for inflation and deflation of the closed body".

Further, the specification devotes 1 and one half pages, beginning a page 7, line 21, through page 9, line 2, in describing a manner of molding a seamless elastomeric composite with a hollow interior connected to fluid and electrical ports. Reference is also made to Figure 2.

In regard to the Examiner's comments regarding Figure 4 of the disclosure showing the seamless closed body having a open end, it is noted that Figure 4 is to be read with Figures 1, 3 and 5. (Figures 1, 3, 4, and 5 are contained in Exhibit No. A of the Appendix of Evidence.) Figure 4 illustrates a cross sectional view of the inflatable bladder. Figure 1 is a cross sectional detail of the wall of the bladder. Figure 3 illustrates a side perspective view of the inflated bladder within the pipe. Figure 5 is another side view illustration of the bladder.

Returning to Figure 4, it appears the Examiner has correctly observed that the electrically conductive elements 201 are not in contact with the electrically conductive band 103. This band, which is placed around the circumference of the inflatable bladder, is in electrical communication 106 with the electrical cable 11. The Examiner may also have correctly observed that the connecting or sealing bands 101 are not shown in Figure 4 to be banding or sealing the composite 205 to the front end piece 6. Contrast Figure 4 with Figures 3 and 5.

The text of the disclosure explaining the Figures 3, 4 and 5 states as follows:

> "Figures 3-5 show the elastomeric composite 205 integrated into a heater/inflation module 210. *The module includes front and rear end pieces 6, 8 to effectively seal the interior of the composite 205.* Thus the front and rear end pieces 6, 8 are permanently attached to the front and rear ends of the composite 205 and sealed by sealing means 112, 101. ... ."
>
> "In the embodiment shown in Figures 4 and 5, the front end piece 6 (as well as the rear end piece 8) includes a metallic contacting band 103 and a sealing mechanism sealing bands

101. The bands 101, 103 may be constructed of type 201 stainless steel having ½ inch width. *As shown in Figure 5, the bands 101, 103 may be secured to the composite 205 by conventional means such as type 301 stainless steel set screw buckles 112.* The end pieces 6, 8 are constructed from cast or machined aluminum or a fiber-reinforced, high-temperature plastic material. *The end pieces 6, 8 also have at least one circumferential groove 113 serving as a mechanical attachment point between the composite 205 and the end pieces 6, 8 and to increase the sealing surface area. The metallic bands 103 ensure electrical continuity and the transfer of electrical energy to the conductive heating core 201 of the composite 205.* As preferably shown in Figure 4, an electrical input line within electrical conduit 11 leads through the front end piece 6 to the conductive metallic band 103 and is connected thereto by an internal terminal 106. An electrical output line 12 enters through the front end piece 6, runs longitudinally through the inflation chamber 102, and contacts the heating element layer 201 at the rear end piece 8 to complete the resistive heating circuit. This arrangement effectively creates a circuit for electrical energy to pass through the entire composite 205 while only requiring external electrical connections at one end piece." (emphasis added)

It is the Appellant's position that a portion of one drawing (Figure 4) may not be fully consistent with the accompanying explanatory text. However, reading the complete disclosure, including the above quoted section, and comparison of Figures 2, 3 and 5 with Figure 4 would allow a person of ordinary skill in the art to understand the invention as claimed. Again, the written description requirement does not require the applicant to describe exactly the subject matter claimed, but instead the description must clearly allow persons of

ordinary skill in the art to recognize that he or she invented what is claimed. Moba B.V. v. Diamond Automation Inc., 325 F3d at 1321, 66 USPQ2d at 1439.

Again referencing the MPEP for guidance, MPEP §2163 II A, states the Examiner "has the initial burden of presenting evidence or reasoning *to explain why persons skilled in the art would not recognize in the disclosure a description of the invention defined by the claims.*" It is the Appellant's position that the Examiner has not met this burden. The Examiner has merely made an assertion and failed to provide the required explanation.

For the reasons stated above, the invention subject of claim 26 is clearly disclosed in the specification text and drawings.

The Examiner's assertion regarding the "unclosed" body is also without merit. It contorts one drawing to the exclusion of 3 accompanying drawings and the clear text of the written specification.

The Examiner's rejection of claim 26 and dependant claims 27 and 28 should be rescinded and the claims allowed to issue.

ISSUE No. 3

Whether the Examiner has met his burden to provide objective evidence to reject independent claims 12 and 26, as well as dependant claims 13 and 27, under 35 U.S.C. §103(a) as being unpatentable over Japan '334 (JP 2-150334) in view of Japan '161 (JP 6-234161) or Japan '323 (JP 2-158323) and in view of Hollingsworth (US 5266137) and optionally further in view of Wood et al (US 5706861) and Guenthner et al (US 5216085).

All of the appealed claims have been rejected as obvious over Japan '334 in view of Japan '161 or Japan '323 and further in view of Hollingsworth. Therefore the deficiencies of the Examiner's rejection discussed in this Issue No. 3 apply equally to Issues 4, 5, 6 and 7.

The claims at issue state:

> 12. An apparatus for curing a pre-preg repair material supporting a heat curable resin for in-situ repair of a conduit, comprising:
>
> *an elastomeric composite having a first end and a second end, wherein the composite includes a non-ferrous heating element comprised of carbon fibers, graphite fibers, carbon filaments or graphite filaments and disposed within a thermoset resin matrix;*
>
> a first end piece fixedly attached to the first end of the composite and having an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and *at least one electrical cable port to convey electric current to the non-ferrous heating element from a power supply source*; and
>
> a second end piece fixedly attached to the second end of the composite, wherein the composite, the first end piece, and the second end piece form a generally hollow inflation chamber.
>
> 13. The apparatus of Claim 12 wherein the thermoset resin

is selected from the group consisting of fluorocarbon and fluorosilicone.

26. An inflatable heating device having a generally cylindrical body for internal in-situ repair of pipe shaped objects comprising:

an elastomeric seamless composite closed body having a generally cylindrical shape formed of at least one layer of a *flexible elastomeric material having a first inner surface and a second outer surface, a plurality of nonmetallic, electrically conductive fibers comprising carbon fibers, graphite fibers, carbon filament or graphite filaments* and located substantially throughout the length of the cylindrical shaped body between the first inner surface and second outer surface of the flexible elastomeric material;

at least one electrically conductive cable port connecting the electrically conductive fibers to an electrical power source; and

at least one air port for inflation and deflation of the closed body.

27. The inflatable heating device of Claim 26 wherein the generally cylindrical body has an outer diameter sized to allow the second outer surface to contact an inner surface of a repair object to transfer electrical resistive heat energy created by the conductive fibers located between the first inner surface layer and second outer surface layer when energized by the electrical power source and the body is inflated.

(emphasis added)

Each of the appealed claims require use of carbon or graphite fibers or filaments. *The Examiner concedes that the only reference for use of carbon or graphite fibers is Hollingworth.* This concession in made in the Examiner's advisory action dated May 23, 2005 wherein he states that rejection of claims 12, 13, 26, and 27, the subject matter of the non-metallic electrically conductive

fibers comprising carbon fibers, graphite fibers, carbon filaments or graphite filaments "requires the use of Hollingsworth". This advisory action is contained in Exhibit No. B.

First, it is the Appellant's position that the Examiner has not demonstrated the required motivation or suggestion for a person skilled in the art of in situ pipe repair (subject matter of the invention claimed by the Appellant) to combine the teachings Hollingsworth. In the absence of this showing, the Examiner can not find the Appellant's invention obvious over Japan '334.

In the May 23, 2005 office action the Examiner stated " the subject matter of the non-metallic electrically conductive fibers comprising "carbon fibers, graphite fibers, carbon filaments or graphite filaments" *requires* the use of Hollingsworth and was addressed in paragraph 11 of the final office action; Japan '334 teaching the use of non-metallic electrically conductive fibers for resistive heating of an inflatable heating device and Hollingsworth suggesting the use of carbon fibers as resistive heating elements." (emphasis added)

In paragraph 11 of the final office action (dated February 18, 2005) the Examiner states "*Hollingsworth contains the additional teaching of the use of carbon fibers for resistive heating.*" (emphasis added) The relevant paragraphs of the Examiner's final office action are contained in Exhibit No. C.

The Examiner later states "(a)s to carbon fibers, note the suggestion from Hollingsworth that electrical resistive heating elements include carbon fibers."

The Examiner later states "it would have been obvious to use carbon fibers in Japan '334's inflatable heating device since Hollingsworth, directed to a mandrel having an inflatable support (bladder), teaches that **carbon fibers** may be used as resistance heating elements (column 10)." (emphasis original).

With due respect, the Examiner is wrong. Hollingsworth doesn't say anything about carbon fibers in an inflatable bladder. Hollingsworth teaches putting carbon fibers in a *rigid, dimensionally stable mandrel* that is supported by one or more separate inflatable bladder(s). The stiff rigid mandrel containing the carbon fibers is separate from the inflatable bladder. The Examiner appears to be misconstruing Hollingsworth. A copy of the Hollingsworth patent is attached

in Exhibit No. D

As discussed infra, the Examiner's assertion of "it would have been obvious to use carbon fibers" is also not specific and particular objective *evidence* of motivation or suggestion to combine references as required to make a prima facie case of obviousness.

The law is clear that the Examiner bears the initial burden of presenting a prima facie case of obviousness under 35 USC §103(a). See for example In re Rijckaert, 9 F.3d 1531, 1532, 28 USPQ2d 1955, 1956 (Fed. Cir. 1993). For a prima facie case of obviousness to exist, there *must* be "*some objective teaching* in the prior art or ... knowledge generally available to one of ordinary skill in the art (that) would lead that individual to combine the relevant teachings of the references." In re Fine, 837 F2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988) (emphasis added). "The showing must be clear and particular." In re Dembiczak, 175 F3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999), citing C.R. Bard, 157 F3d at 1352, 48 USPQ 2d at 1232.

A conclusion of obviousness is error when it "did not *elucidate* any factual teachings, suggestions or incentives from this prior art *that showed the propriety of combination*." Ashland Oil, Inc. v. Delta Resins & Refractories, Inc., 776 F2d 281, 297, 227 USPQ 657, 667 (Fed. Cir. 1985) (emphasis added)

Second, Hollingworth is in a separate and distinct technology. Entitled "Rigid Segmented Mandrel with Inflatable Support," Hollingsworth relates to mandrels which are used as internal supports for the fabrication of hollow structures such as pressure vessels, cases for solid propellant rocket motors, fuel tanks, aircraft fuselages and the like. (See column 1, beginning at line 6.)

Japan '334 is the primary reference cited by the Examiner. In contrast to Hollingsworth, Japan '334 is described by the Examiner as follows:

> "Japan '334 directed to insitu pipe repair, discloses an apparatus for repairing a pipe using a repairing sleeve having curable adhesive comprising:
>
> - An inflatable heating device comprising a cylindrical cloth and an expandable air tight layer;

- A pressurized fluid conduit 11 and a hole 10 for inflating the cloth and air tight expandable layer;
- An electric current feeding device, electrical wire 9 and metallic tapes 8, 8' to supply current to the cloth 7 so that the cloth 7 generates heat." (emphasis original)

The Examiner further states "Japan '334, Japan '161 and Japan '323 *are in the same field of endeavor – lining / repairing a pipe and share the common subject matter of supplying heat during repair / lining of a pipeline using heating.*" (emphasis added) Japan '334, Japan '161 and Japan '323 are attached as Exhibits Nos. E, F & G respectively.

Hollingsworth, relating to rocket motors, etc., is not subject matter common with Japan '334, the Examiner's primary reference. It is *not* in the same field of endeavor. *Hollingsworth has nothing to do with pipe repair. Hollingsworth makes no reference to resistively heating an inflatable bladder using carbon fibers.* The Examiner can not use Hollingsworth as a reference teaching to one of ordinary skill in the relevant art, with the reference before him, to make the proposed combination, i.e., embedding carbon fibers within an *inflatable* module or bladder for electrical heating.

The fact that references can be combined does not make the combination obvious. It is also clear that obviousness is not a creation of hindsight. Combining prior art references without evidence of such a suggestion, teaching or motivation simply takes the inventor's disclosure as a blueprint for piecing together the prior art to defeat patentability, the essence of hindsight. See In re Dembiczak, 175 F3d at 999, 50 USPQ2d at 1617 (Fed. Cir. 1999), citing Interconnect Planning Corp. v. Feil, 774 F2d 1132, 1138, 227 USPQ 543, 547 (Fed. Cir. 1985). To avoid the "subtle but powerful attraction of a hindsight-based obviousness analysis," the Federal Circuit requires "a rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references." In re Dembiczak, 175 F3d at 999.

Again, the Examiner has made only an assertion that it would have been obvious to use carbon fibers.

Third, there is no basis for combining Hollingsworth with Japan '334, in view of Japan 161 or Japan 323. Hollingsworth is attempting to solve a vastly different problem than the Japanese references. As discussed in detail below, Hollingsworth is attempting to construct a rigid, dimensionally stable mandrel. The segmented mandrel of Hollingsworth containing carbon fibers for resistive heating is *not* an expandable or inflatable bladder (in contrast to each of the Japanese references).

Hollingsworth states at col. 3, lines 45 through 49, that "an extremely important design requirement for a fibrous composite mandrel is that it must be rigid and not deflect, move or change shape under part fabrication and curing loads." This is opposite the properties sought in an inflatable bladder subject of the Appellant's invention.

Hollingsworth teaches use of carbon fibers as a component of the rigid mandrel segments. (Column 10, lines 32 through line 36.) The Appellant's invention uses carbon fibers embedded in the inflatable (hence flexible) bladder module.

Hollingsworth, at column 10, beginning at line 19, states:

> "Electrical resistance heating methods are easily adapted to this invention because each of the *mandrel segments* is a single piece. This makes it easy to provide an electrical path from one end of the mandrel to the other since no intermediate connections are required. Several methods could be used for resistance heating of the *segments*. The most preferred method is to embed an electrical resistance heating wire, such as nickel-chromium, in the composite *segments* when they are fabricated. .... In yet another embodiment, the carbon fibers used to fabricate the *segment* may be used as a resistance heating elements provided a means is incorporated during fabrication to attach the necessary electrical power to the fibers." (emphasis

added)

To put this quotation in some perspective, the Hollingsworth disclosure states in column 5 beginning at line 36 that:

> "When assembled, the *segmented mandrel* and inflatable support of the present invention is lightweight, rigid, dimensionally stable and uses no internal mechanical supports or fasteners."

The Examiner has not provided any objective evidence, i.e., a teaching, suggestion or motivation, within Hollingsworth for utilizing carbon fibers with an expandable bladder. But the Examiner has stated it is within Hollingsworth that we must look. The Examiner has asserted "*Hollingsworth contains the additional teaching of the use of carbon fibers for resistive heating.*" (See the bottom of page 11 of the Examiner's final office action, Exhibit No. C.)

In the absence of objective evidence of such a teaching, suggestion or motivation, i.e., teaching carbon fibers within an expandable bladder, the finding of obviousness must be rejected as a matter of law. See Dembiczak at page 1000, citing C.R. Bard, at 1352. As the Appellant explains in Issue 4 below, Hollingsworth in fact teaches away from the combination urged by the Examiner.

Citing In re Sang Su Lee, 277 F3d 1338, 1343, 61 USPQ2d 1430, 1434 (Fed. Cir. 2002), there must be an explanation of "the reasons one of ordinary skill in the art would have been motivated to select the references and to combine them to render the claimed invention obvious." This factual question of motivation is material to patentability, and could not be resolved on subjective belief and unknown authority. In re Sang Su Lee, 277 F3d at 1344.

As stated above, motivation to combine Hollingsworth with the Japanese references can not be found by similarity of problems being solved. This is clear when contrasted with the facts of the Federal Circuit decision in which motivation was found.

In Ruiz v A.B. Chance Company, 357 F3d 1270, 1276, 69 USPQ2d 1686,

1690 (Fed. Cir. 2004), the court stated that motivation may properly be found to combine two references when "the two references address *precisely* the same problem ... ." The court found "because the prior art references address the *narrow problem* of underpinning existing building foundations, a person seeking to solve that *exact same problem* would consult the references and apply their teachings together." (at 1277) (emphasis added) Again, Hollingsworth has nothing to do with pipe repair, the subject matter of the Appellant's invention.

These principles were recently affirmed by the Federal Circuit in Teleflex, Incorp. & Tech. Holding v. KSR Int'l., 04-1152 (Fed. Cir. 2005). Quoting from Teleflex:

> "In re Rouffet, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1459 (Fed. Cir. 1998) ("In other words, the examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed." (emphasis added by the Teleflex court)).
>
> "Under our case law, whether based on the nature of the problem to be solved, the express teachings of the prior art, or the knowledge of one of ordinary skill in the art, the district court was required to make specific findings as to whether there was a suggestion or motivation to combine the teachings of Asano with an electronic control in the particular manner claimed by claim 4 of the '565 patent. See Kotzab, 217 F.3d at 1371; Rouffet, 149 F.3d at 1357. That is, the district court was *required to make specific findings as to a suggestion or motivation* to attach an electronic control to the support bracket of the Asano assembly. (emphasis added)
>
> "The district court correctly noted that the nature of the problem to be solved may, under appropriate circumstances, provide a suggestion or motivation to combine prior art

references. However, *the test requires that the nature of the problem to be solved be such that it would have led a person of ordinary skill in the art to combine the prior art teachings in the particular manner claimed.* See Rouffet, 149 F.3d at 1357. *We have recognized this situation when two prior art references address the precise problem that the patentee was trying to solve*. See Ruiz, 357 F.3d at 1276 ("This record shows that the district court did not use hindsight in its obviousness analysis, but properly found a motivation to combine because the two *references address precisely the same problem* of underpinning existing structural foundations."). In this case, the Asano patent does not address the same problem as the '565 patent. The objective of the '565 patent was to design a smaller, less complex, and less expensive electronic pedal assembly. The Asano patent, on the other hand, was directed at solving the "constant ratio problem." The district court's reliance on the problems associated with the Rixon '593 patent similarly fails to provide a sufficient motivation to combine. This is because the Rixon '593 patent does not address the problem to be solved by the `595 patent; rather, it suffers from the problem. The court did not explain how suffering from the problem addressed by the '595 patent would have specifically motivated one skilled in the art to attach an electronic control to the support bracket of the Asano assembly." (emphasis added)

It is the Appellant's position that the Examiner has not and can not supply evidence of motivation to utilize Hollingsworth. It is teaching the use of carbon fibers for resistive heating of a stiff, rigid, non-expanding mandrel. Again, Hollingsworth has nothing to do with pipe repair.

The Appellant's invention, as does Japan '334 (the primary reference), pertains to in situ repair of pipes or conduit using an elastomeric (expandable)

composite or module containing carbon fiber as a resistive heating device. Hollingsworth teaches a rigid, fixed dimensioned and segmented mandrel for filament winding of composite shells such as "pressure vessels, rocket motor cases, aircraft fuselages and other hollow structures". (Column 5, lines 32 through 34.) The mandrel is designed and intended *not* to inflate. The module of the Appellant's invention, an "Inflatable Heating Device," is intended to inflate.

Further, the Examiner has referenced Wood et al, US Pat. 5,706,861, Guenthner et al, US Pat. 5,216,085 as well as Hollingsworth for as "each suggesting cured material for the bladder". (Wood et al. is attached in Exhibit No. H and Guenthner et al. is attached in Exhibit No. I.)

First, neither Woods nor Guenthner provide any suggestion or motivation for incorporating any type of heating mechanism on or within an expandable or inflatable bladder. There is certainly no reference to carbon fibers as a source of resistive heating combined with an inflatable bladder.

Second, Guenthner et al., entitled "Method for Curing Fluoroelastomer Compositions Containing Fluoroaliphatic Sulfonamides as Curing Agents", only teaches a method of vulcanizing fluorocarbon elastomers. It provides no suggestion or motivation for the use of such substances for an inflatable bladder. It certainly provides no motivation or teaching for use of such elastomers for pipe or conduit repair. There is no reason or explanation offered why the ordinary person skilled in the art of in situ pipe repair would look to Guenthner et al.

The Appellant has already explained that Hollingsworth provides no motivation or suggestion to combine carbon fibers for resistive heating in combination with an inflatable bladder. In addition, it has already been explained that the Examiner has not supplied any evidence of a motivation or suggestion regarding utilizing Hollingsworth for in situ pipe repair.

The following excerpt from In re Dembiczak, 175 F3d at 1000, seems particularly applicable:

> Nowhere does the (Examiner) particularly identify any suggestion, teaching, or motivation to combine the (references) ... nor does the (Examiner) make specific — or even inferential

— findings concerning the identification of the relevant art, the level of ordinary skill in the art, the nature of the problem to be solved, or any other factual findings that might serve to support a proper obviousness analysis.

Accordingly, the Examiner has failed to meet the burden of establishing a prima facie case of obviousness. The Examiner has not shown the use of carbon fibers for resistive heating within an inflatable bladder for in situ pipe repair. This use of carbon fibers is a material element of the Appellant's claimed invention.

The law is clear that all of the claim limitations must be taught or suggested by the prior art. "Obviousness requires a suggestion of all limitations in a claim". CFMT, Inc. v. Yieldup International Corp., 349 F.3d 1333, 1342, 68 USPQ2d 1940, 1947 (Fed. Cir. 2003) citing In re Royka, 490 F.2d 981, 985 (CCPA 1974) Dependent claims are non-obvious under section 103 if the independent claims from which they depend are non-obvious. See for example In re Fine, 837 F2d 1071, 1076, 5 USPQ2d 1596 (Fed. Cir. 1988).

Therefore the invention subject appealed claims 12 and 26 must be allowed to issue. Dependant claims 13, 14, 15, 16, 27 and 28 must also be allowed to issue.

ISSUE No. 4

Whether the combination of references urged by the Examiner is permissible. Specifically is the intended function of Japan '334 or Hollingsworth destroyed by the combination urged by the Examiner and thereby the Hollingsworth reference teaches away from the combination.

Note again that all of the claims subject of appeal have been rejected under 35 U.S.C. §103(a) as being unpatentable over Japan '334 in view of Japan '161 or Japan '323 and in view of Hollingsworth and optionally further in view of at least one additional reference.

It is the Appellant's position that the combination urged by the Examiner is inoperable. Japan '334, the primary reference, would be inoperable for its intended purpose if modified by the teaching of Hollingsworth. Therefore the references may not be combined. This is a fatal flaw the runs through the Examiner's entire rejection since the Examiner relies upon Hollingsworth for suggesting a material element of the Appellant's claimed invention, i.e., the use of carbon fibers for resistive heating of the inflatable bladder.

Japan '334 is the primary reference cited by the Examiner. As stated by the Examiner:

> "Japan '334, directed to in situ pipe repair, discloses an apparatus for repairing a pipe using a repairing sleeve having curable adhesive comprising:
>
> - An inflatable heating device comprising a cylindrical cloth and an expandable air tight layer;
> - A pressurized fluid conduit 11 and a hole 10 for inflating the cloth and air tight expandable layer;
> - An electric current feeding device, electrical wire 9 and metallic tapes 8, 8' to supply current to the cloth 7 so that the cloth 7 generates heat.
>
> The air tight layer may be elastic resin or rubber. On both ends of the cylindrical cloth metallic tape 8, 8' are wrapped around and fixated to the outer periphery. These metallic tapes

have electricity fed to them from a power feeding device via power lines 9. The cloth (fabric) may comprise threads such as crimped polyethylene terephathalate threads wherein the threads are coated with or contain conductive carbon particles. Hence: Japan '334 discloses resistively heating an inflatable heating device for insitu pipe repair using electrically conductive non-metallic threads and thereby substantially discloses the claimed invention. Japan '334 does not recite embedding the electrically conductive fibers nonmetallic in the expandable body."

The Examiner further states that as to claim 12,

"it would have been obvious to one of ordinary skill in the art to embed the electrically conductive non-metallic fibers, which are to be resistively heated, in the expandable layer of Japan '334's inflatable heating device (device for heating lining material for pipe repair) in view of Japan '161's teaching to embed an electrically conductive element, which is to be resistively heated, in an expansion tube (device for heating lining material for a pipe) or (2) Japan '323's teaching to embed electrically conductive wires, which are to be resistively heated, in a heater tube (device for heating lining material of a pipe) comprising a film 4 and a tube 2. *Japan '334, Japan '161 and Japan '323 are in the same field of endeavor – lining / repairing a pipe and share the common subject matter of supplying heat during repair / lining of a pipeline using heating.*" (Emphasis supplied).

Again, Hollingsworth, cited by the Examiner for teaching use of carbon fibers within an expanding inflatable bladder for resistive heating, has nothing to do with pipe lining or pipe repairing. Hollingsworth incorporates the carbon fibers

in a stiff, rigid and non expanding, non inflating mandrel. None of Japan '334, Japan 161 or Japan '323 utilize or incorporate a stiff or rigid mandrel.

Hollingsworth teaches a rigid, fixed dimensioned and segmented mandrel for filament winding of composite shells such as "pressure vessels, rocket motor cases, aircraft fuselages and other hollow structures". (Column 5, lines 32 through 34.) The mandrel is designed and intended *not* to expand.

Hollingsworth states at col. 3, lines 45 through 49, that "an extremely important design requirement for a fibrous composite mandrel is that it must be rigid and not deflect, move or change shape under part fabrication and curing loads." This is opposite the properties sought in an inflatable bladder subject of Japan '334.

Hollingsworth teaches use of carbon fibers as a component of the rigid mandrel segments. Use of the carbon fibers for resistive heating is a secondary motivation to use carbon fibers within the rigid mandrel. (Column 10, lines 32 through line 36.)

Further "(w)hen assembled, the *segmented* mandrel and inflatable support of the present invention is lightweight, *rigid*, *dimensionally stable* and uses no internal mechanical supports or fasteners." (Column 5, lines 36 through 39.)

Hollingsworth teaches using multiple fluid inflatable internal bladders to "push outward against the plurality of *segments and lock them in a rigid position.*" (Column 5 lines 60 & 61.) The Hollingsworth patent describes the structure at column 5, line 63 through column 6, line 13, as follows;

> "The design of the *overlapping and interlocking joint element used in joining the segments* is such that the application of the positive pressure from the bladders causes the segments to lock together, *creating a rigid monocoque mandrel structure* the outside surface of which carries the structural loads. ... Even though the outside diameters of most pressure vessels, rocket motor cases and aircraft fuselages are relatively large, use of the monocoque mandrel of the present invention results in *a very rigid mandrel structure*. This is especially significant when compared to current

prior art mandrels, which use a relatively small (less then (sic) 10 inches in diameter) longitudinal steel tube (shaft) to carry all of the loads." (emphasis added.)

The Hollingsworth device, as indicated, includes interlocking joints holding the segmented rigid mandrel in a fixed dimension. This is not an inflatable mandrel suitable for pressing a pipe repair material against the irregular shape of a pipe inner surface. Specifically, Hollingsworth states at Column 7, lines 23 through 26, that "(b)oth types of joints are designed to prevent movement in two directions, namely, radially outward and circumferential apart." The function of the internal inflatable bladders in relation to the rigid mandrel segments is further explained at Column 9, lines 14 through 16, stating "(t)he internal bladders used to *pressurize the inside of the mandrel* and hold the segments in place can be filled with a gas such as air or nitrogen."

Clearly, it is intended that the diameter of the rigid mandrel of the Hollingsworth device not expand outward. Fixed dimensions are an essential feature of the Hollingsworth structure. Carbon fibers are not taught or suggested for the flexible inner support bladder. Carbon fibers are intended primarily to increase the stiffness and decrease the weight of the mandrel. "Due to the high strength and anisostropic properties of carbon/epoxy composite materials, ..." "This results in the lightest, strongest and most accurate mandrel possible." (Quoting from Hollingsworth beginning at Col. 6, line 64.)

The function of Hollingsworth would be destroyed if there was no rigid, dimensionally stable mandrel. To modify Hollingsworth to remove the rigid, segmented mandrel and insert carbon fibers into a flexible, expandable bladder would destroy the intended function of the device. The function of the device is to supply an internal mandrel around which fibers or fabric can be wound or laid up for the fabrication of fiber composite structures.

Conversely, the use of a rigid, fixed dimensioned mandrel would destroy the intended function of Japan '334, which is for an expandable body pressing against the inner surface of a pipe wall.

It has been consistently held that when a §103 rejection is based upon a modification of a reference that destroys the intent, purpose or function of the invention disclosed in the reference, such a proposed modification is not proper and the *prima facie* case of obviousness can not be properly made. "An inoperable modification teaches away" In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). See also McGinley v. Franklin Sports Inc., 262 F3d 1339, 1354, 60 USPQ2d 1001, 1010 (Fed. Cir. 2001). "If references taken in combination would produce a 'seemingly inoperative device', (the courts) have held that such references teach away from the combination and thus cannot serve as predicates for a prima facie case of obviousness." Citing In re Sponnoble, 405 F2d 578, 587, 160 USPQ 237, 244 (CCPA 1969).

In Tec Air Inc. v. Denso Manufacturing Michigan Inc., 192 F3d 1353, 1360, 52 USPQ2d 1294, 1298 (Fed. Cir. 1999), the court found combining a reference for a smooth brass plug accessible on the inside surface of a mold cavity with separate art requiring access to slotted screw heads *would not be operable for its intended purpose to due to molded plastic residue clogging the screw head slots*. The court therefore upheld a finding that referenced patent taught away from the combination.

It is important to note that Appellant's argument is not about two references that merely have different goals or that are designed to resolve different problems. Rather, and at a minimum, the line of development flowing from the Hollingsworth patent, i.e., a rigid, fixed dimensioned and segmented mandrel for composite filament winding manufacture, is unlikely to be productive of the result sought, i.e., an inflatable apparatus for heating a repair liner for insitu pipe repair. Therefore it can *not* be the basis or reference for a rejection based upon obviousness. See National Steel Car v. Canadian Pacific Rail., 357 F3d 1319, 1339, 69 USPQ2d 1641, 1656 (Fed. Cir. 2004)

Hollingsworth is the Examiner's single reference for teaching resistively heating an inflatable bladder by means of carbon fibers. The reference is, however, fatally flawed. It is not a permissible reference.

In addition to being unrelated to the subject matter of the primary

reference and directed a different problem, Hollingsworth is teaching away from the combination urged by the Examiner.

In the absence of the Hollingsworth reference, the Examiner is unable to find suggestions for all of the elements or claim limitations of the Appellant's invention. The obviousness rejection falls apart. The ten appealed claims must be allowed.

ISSUE No. 5

Whether the Examiner has met his burden to provide objective evidence to reject dependent claim 28 under 35 U.S.C. §103(a) as being unpatentable over Japan '334 (JP 2-150334) in view of Japan '161 (JP 6-234161) or Japan '323 (JP 2-158323) and in view of Hollingsworth (US 5266137) and optionally further in view of Renaud (US 4861634).

The Appellant has stated the deficiencies in the Examiner's rejection over the combined Japanese patents in view of Hollingsworth and Wood et al and Guenther et al. This was addressed in the argument to Issue No. 3. The Examiner's addition of the reference to Renaud does not cure the inherent flaw discussed in the Appellant's arguments to Issues 3 and 4. (Renaud is attached as Exhibit No. J.) Again, the Examiner has admitted Hollingsworth is the required reference for the utilization of carbon to resistively heat the inflatable bladder.

Claim 28 of the Appellant's invention states:

> "The inflatable heating device of Claim 26 further comprising components *to monitor heat of the composite body and to control resistive heating.*" (emphasis added)

Renaud pertains to a method for internally lining ducts. It utilizes two sleeves. The first outer layer is a thermosetting resin impregnated fabric carrying a fluid impermeable envelope. The second inner layer also has a fiber outer layer capable of adhering to the first layer after hardening of the resin. The envelope, and first and second sleeve, form the repair liner. In one embodiment, a separate balloon is used to press the combined liner to the inner surface of the duct. In another embodiment, the first outer fabric sleeve (repair liner) includes electrically conductive metal wires. Renaud is offered by the Examiner for disclosing electrical resisitive heating and teaching maintaining temperature at a desired temperature using means for controlling temperature connected to the ends of the metal wires. The Examiner references Renaud col. 5, lines 65-68, that states:

"The ends of the wires 40 are connected to means for controlling the temperature, known per se, not shown in FIG. 4) (sic) these means being uncoupled after the lining operation."

It is the Appellant's position, and which it is believed the Examiner would not dispute, that Renaud does not provide any suggestion or motivation for the use of carbon fibers within an expandable or inflatable bladder for resistive heating. It also does not suggest or motivate the use of carbon fibers for resistive heating within the repair lining. The heating is accomplished by metal wires incorporated in the separate lining sleeve that is left in place after the liner is cured. See Renaud, col. 5, line 50, stating:

"These wires 40 are therefore an integral part of strands 30 and remain in the fabric after hardening of the resin, during application of the lining sleeve in the duct."

The Examiner acknowledges in the February 18, 2005 final office action, that Renaud teaches only conductive wires placed in the lining material for resistively heating and not within the inflatable bladder. The Examiner states:

"Renaud's (teaches) one of ordinary skill in the pipelining/pipe repairing art to use a combination of reinforcing fibers such as glass fibers and conductive wires *for resistively heating in a lining material* ... ." (emphasis added)

Renaud is not a suitable reference in as much as the heating is accomplished by metal stripes or wires *within the liner to be installed*, and not by resistive heating within the composite module/bladder. Renaud is controlling the heating of the liner. The Appellant is monitoring and controlling the temperature of the composite module/bladder and not the liner material. No where does Renaud suggest heating or controlling the heating of the bladder.

ISSUE No. 6

Whether the Examiner has met his burden to provide objective evidence to reject dependant claims 14-16 under 35 U.S.C. §103(a) as being unpatentable over Japan '334 (JP 2-150334) in view of Japan '161 (JP 6-234161) or Japan '323 (JP 2-158323) and in view of Hollingsworth (US 5266137) and optionally further in view of Baker et al (US 4191383) and optionally Rankin (US 1362351) and Renaud (US 4861634).

Again, the inapplicability of Hollingsworth in combination with the three Japanese patents, and particularly with the primary reference, Japan '334, has already been thoroughly discussed. This discussion is contained in Issue 3 and Issue 4.

The inapplicability of the Renaud has also been discussed in Issue No. 5.

The appealed claims subject of this issue read:

> "14. The apparatus of Claim 12 wherein the heating element includes a plurality of braided fibers comprising temperature tolerant fiber braids and electrically conductive fiber braids.
>
> 15. The apparatus of Claim 14 wherein the braided fibers interact to define a braid angle measure at +/- 45 degrees.
>
> 16. The apparatus of Claim 14 wherein the electrically conductive fiber braids are carbon filaments."

The Examiner has offered Baker et al. for suggesting the use of braided material in an inflatable bladder. Baker (Exhibit No. K) is also offered for suggesting helically arranged fibers.

Baker et al. teaches a method and apparatus for sealing underground well casings. This is not the same art as the Appellant's invention, i.e., pipe repair and pipe lining. Unlike Ruiz v. A.B. Chance Company, 357 F3d 1270, 1276, 69 USPQ2d 1686, 1690 (Fed. Cir. 2004), wherein motivation to combine references was found "because the two references address precisely the same problem", Baker does not address the "narrow problem" of in situ repair of pipes. (See Ruiz at 1277) Baker pertains to an inflatable well packer. It is an unrelated

application directed as resolving different problems. Baker states:

> "An inflatable packer is a *downhole tool* which can be inflated with well fluid to seal off the annular space between, for example, the casing and the wellbore. It may also be used inside a casing." (Col. 1, lines 12 through 15) (emphasis added)

> "The inflatable packer element of the present invention includes an inflatable bladder means having a braided wire reinforcing element." (Col 1, lines 43 through 45)

Although steel braid is presumably electrically conductive, there is no suggestion or motivation taught within Baker for utilizing this property in any manner. It is not known if the architecture of the braid is suitable to be a segment of an electric circuit and no means are disclosed that would enable electrical power to be conveyed to each end of the braid structure. There is no suggestion or motivation for using the braid for resistive heating. There is no suggestion or motivation within Baker et al. for heating anything.

There is also no motivation or suggestion for using the braided structure for lining or repair a pipe. The Baker states the purpose of the well packer is to plug the annulus of a well bore, not to repair a well casing. More important, the detailed description of the well packer in Baker et al. discloses the well packer being used on the outer surface of the well casing. Baker also does not teach a braid angle measure of +/- 45 degrees (appealed claim 15).

The Examiner has offered Rankin (Exhibit No. L) in combination with Renaud to suggest use of temperature tolerant and electrically conductive fibers windings. Renaud is offered for teaching the combination of non-conductive reinforcing fibers such as glass fibers and conductive wires for resistively heating in a lining material.

Renaud does not , however, teach use of temperature tolerant fibers in combination with heating wires. There is no teaching that temperature tolerance

is a desired property. Renaud states only that:

> "In a first embodiment, an assembly comprising an outer *envelope 1 made from a sealed synthetic material and impermeable to fluids – for example PVC* - is introduced into the duct then a first *sleeve 2 is introduced made from a composite material with a glass mat or glass fabric basis for example,* permeable over the whole of its thickness to a heat hardenable resin before polymerization and coated with such a resin, as well as a *second sleeve 3 in the form of a sheet 3_1 made from a synthetic material such as polyethylene, PVC*, etc., whose upper face carries fibers capable of adhering to the lower face of said first sleeve 2 after hardening of the resin." (beginning at Col. 3 line 64 through Col. 4, line 8) (emphasis added)

Renaud further discloses an embodiment stating:

> "This woven fabric forms at least one of the layers of the of the composite material of said first sleeve. Each strand 20, 30 may be a strip of an *appropriate material*, such for example as a *synthetic material* glass, ceramic, carbon and similar; or else formed by a multiplicity of fibers of *appropriate materials* disposed side by side, or else by multifiber cores.
>
> Heating elements in the form of metal wires 40 may be either disposed on certain strips or be integrated in the multiplicity of fibers for the strands 30. The wires 40 are therefore an integral part of strands 30 and remain in the fabric after hardening of the resin, during application of the lining sleeve in the duct." (Col. 5 beginning line 41 through line 53) (emphasis added)

The Examiner's use of Renaud as a reference requires assumptions or speculation as to its teaching, i.e., what are fibers of "appropriate material". It apparently a synthetic material. Renaud includes PVC as a synthetic material.

However PVC is not a temperature tolerant material. This speculation precedes any analysis of whether it is (i) within the "narrow art" that would be before a ordinary person skilled in the art and (ii) does it teach a suggestion or motivation to combine temperature tolerant fibers with conductive fibers within an inflatable bladder for in situ pipe repair.

> "The examiner may not, because of doubt that the invention is patentable, resort to speculation, unfounded assumption or hindsight reconstruction to supply deficiencies in the factual basis for the rejection." In re Warner, 379 F2d 1011, 1017, 154 USPQ 173, 177 (CCPA 1967), cert. denied, 389 U.S. 1057 (1968).

The Examiner has also cited Rankin, being a patent issued on December 14, 1920. However, this reference does not suggest use of non-conductive filaments with an electrical conductor for purposes of heating a thermoplastic or thermosetting material, heating within a bladder, or heating of articles used in pipe repair (in situ or otherwise). Rankin teaches an electrically heated article, e.g., glove, combining variable intertwining of conductive and insulating fibers. *The insulating fibers are cotton.* There is no suggestion or motivation for combining the teaching of Rankin with an inflatable heating device for in situ repair of pipes.

It is respectfully suggested that the references to Baker et al, Renaud and Rankin are examples of the improper hindsight search of prior art conducted by the Examiner to construct or justify the rejection of the Appellant's claimed invention based upon obviousness. This is exactly the practice that the court overruled and objected to in In re Dembiczak, 175 F3d 994, 50 USPQ2d 1614, (Fed. Cir. 1999), stating:

> "However, rather than pointing to specific information in (prior art references) that suggest the combination with the conventional bags, the Board instead described in detail the similarities between the ... references and the claimed invention, noting that one reference or the other - - in

combination with each other and the conventional trash bags - - described all of the limitation of the pending claims." 175 F3d at 1000.

"Yet this reference-by-reference, limitation-by-limitation analysis fails to demonstrate how the (prior art) references teach or suggest their combination with the conventional trash or lawn bags to yield the claimed invention." 175 F3d at 1000.

"Broad conclusory statements regarding the teaching of multiple references, standing alone, are not 'evidence'." 175 F3d at 999.

"Our case law makes clear that the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references." 175 F3d at 999.

Further, citing the In re Sang Su Lee, 277 F3d 1338, 1343, 61 USPQ2d 1430, 1434 (Fed. Cir. 2002), the court stated:

"In other words, the (Examiner) must explain the reasons one of ordinary skill in the art would have been motivated to select the references and combine them to render the claimed invention obvious."

Also, "(o)ne cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention." In Re Fine, 837 F.2d 1071, 1075, 5 USPQ at 1596 (Fed. Cir. 1988)

These principle were confirmed by the Federal Circuit in Iron Grip Barbell Co., Inc. V. USA Sports, 392 F.3d 1317, 1320, 73 USPQ2d 1225, 1227 (Fed. Cir.

2004), stating:

> *Where an invention is contended to be obvious based upon a combination of elements across different references, our cases require that there be a suggestion, motivation or teaching to those skilled in the art for such a combination.* In re Fine, 837 F.2d 1071, 1074 (Fed. Cir. 1988). This requirement prevents the use of "the inventor's disclosure as a blueprint for *piecing together the prior art to defeat patentability* — the essence of hindsight." Ecolochem, Inc. v. So. Cal. Edison Co., 227 F.3d 1361, 1371-72, 56 USPQ2d 1065, 1073 (Fed. Cir. 2000) (quoting *In re Dembiczak,* 175 F.3d 994, 999 (Fed. Cir. 1999)). (emphasis added)

In view of the factual analysis and the cited case law, Appellant believes that it is clear the Examiner has failed to meet his burden to demonstrate objective evidence of motivation or suggestion to combine the references. The appealed claims 14, 15 and 16 must accordingly be allowed.

ISSUE No. 7

Whether the Examiner has met his burden to provide objective evidence to reject claims 20 and 22 under 35 U.S.C. §103(a) as being unpatentable over Japan '334 (JP 2-150334) in view of Japan '161 (JP 6-234161) or Japan '323 (JP 2-158323) and in view of Hollingsworth (US 5266137) and optionally further in view of at least one of Wood et al and Guenthner et al as applied above and further in view of Lippiatt (US 5,199,463).

Lippiatt (Exhibit No. M) is offered by the Examiner for suggesting removably attaching lining material in the form of a pre-preg (fibrous material impregnated with heat curable resin) to a bladder using loose ties.

First, claims 20 and 22 state:

> 20. A method for repairing a damaged section of a conduit comprising the steps of:
>
> providing an elastomeric composite having a first and second end, wherein the composite includes a non-ferrous electrically conductive heating element comprising carbon fibers, graphite fibers, carbon filaments or graphite filaments and disposed within a thermoset resin matrix;
>
> fixedly attaching a first and second end piece respectively to the first and second ends of the composite, wherein the first end piece, the second end piece, and the composite form a heating/inflation module;
>
> *removably attaching a pre-preg to an outer surface of the composite, wherein the pre-preg includes a structural fiber matrix supporting a heat curable resin;*
>
> positioning the module with the attached pre-preg into the conduit at a damaged location;
>
> inflating the module to a predetermined internal air pressure to expand the composite and press the pre-preg against an inside surface of the conduit;

curing the resin of the pre-preg by causing an electrical current to flow in the heating element to resistively heat the module to a predetermined temperature; and

deflating the module and removing it from the conduit.

22. A system for in-situ repair of a conduit, comprising:

an apparatus including an elastomeric composite having a first end and a second end, wherein the composite includes a non-ferrous heating element comprising carbon fibers, graphite fibers, carbon filaments or graphite filaments and disposed within a thermoset resin matrix;

a first end piece fixedly attached to the first end of the composite and

having an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port to convey electric current to the non-ferrous heating element from a power supply source;

a second end piece fixedly attached to the second end of the composite, wherein the composite, the first end piece. and the second end piece form an inflation chamber; and,

a pre-preg removably attached to an outer surface of the composite of the apparatus, the pre-preg including a structural fiber matrix supporting a heat curable resin. (emphasis added)

Lippiatt states only:

"With the core 13 in its flexible disposition, the bag 12 evacuated and loose ties 17, around the liner under its cover, the assembly is moved along a curved path ... ." (Col. 3, line 50 through 54)

Again, we have to assume or speculate as to the function of the "loose ties". The above quoted passage is the only reference within Lippiatt that might possibly refer to a removeable attachment mechanism. It is noted that item 17 also refers to the tapered ends of the inflator unit. (See Col. 3, line 37, stating "(t)he inflator bag is tapered to a smaller diameter at its ends 17.")

Lippiatt states that prior to insertion of the unit into the pipe, an air pump is connected to the inflator bag "to extract air from the bag to contract it to minimum dimensions". (Col. 3, line 46) *Perhaps the ties are to only to keep the deflated bag within its minimum dimensions and for no other purpose?* We are left to speculate. But an obviousness rejection can not be constructed from speculation. "A rejection based on section 103 clearly must rest on a factual basis, and these facts must be interpreted without hindsight reconstruction of the invention from the prior art." In re Warner, 379 F2d at 1017.

Therefore the reference cited by the Examiner does not disclose a removeably attachment mechanism. Therefore the Examiner has failed to establish a prima facie case of obviousness. The law is clear that all of the claim limitations must be taught or suggested by the prior art. "Obviousness requires a suggestion of all limitations in a claim". CFMT, Inc. v. Yieldup International Corp., 349 F.3d 1333, 1342 (Fed. Cir. 2003) citing In re Royka, 490 F.2d 981, 985 (CCPA 1974)

The Examiner has failed to meet his burden to properly reject claims 20 and 22. Therefore the invention subject of appealed claims 20 and 22 must be allowed to issue as a patentable invention.

CONCLUSION

The Appellant has demonstrated that the rejection of the appealed claims based upon findings of obviousness is fatally flawed. The Examiner has failed to provide objective evidence of motivation, suggestion or commonality of problems to be solved to support the combination of references. The Examiner has urged combination that, upon examination, teach away from combination. In some instances, there appears transparent "hunting" for references. For these reasons, the rejection of the appealed claims should be overturned.

Respectfully Submitted,

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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited on July 17 2005 with the United States Postal Service, postage prepaid, as Express Mail – Post Office to Addressee, in an envelope addressed to the Mail Stop Appeal Briefs, Commissioner for Patents, PO Box 1450, Alexandria Virginial 22313-1450, Mailing Label No. ED806977666US.

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Customer No. 26328

CLAIMS APPENDIX

12. An apparatus for curing a pre-preg repair material supporting a heat curable resin for in-situ repair of a conduit, comprising:

an elastomeric composite having a first end and a second end, wherein the composite includes a non-ferrous heating element comprised of carbon fibers, graphite fibers, carbon filaments or graphite filaments and disposed within a thermoset resin matrix;

a first end piece fixedly attached to the first end of the composite and having an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port to convey electric current to the non-ferrous heating element from a power supply source; and

a second end piece fixedly attached to the second end of the composite, wherein the composite, the first end piece, and the second end piece form a generally hollow inflation chamber.

13. The apparatus of Claim 12 wherein the thermoset resin is selected from the group consisting of fluorocarbon and fluorosilicone.

14. The apparatus of Claim 12 wherein the heating element includes a plurality of braided fibers comprising temperature tolerant fiber braids and electrically conductive fiber braids.

15. The apparatus of Claim 14 wherein the braided fibers interact to define a braid angle measure at +/- 45 degrees.

16. The apparatus of Claim 14 wherein the electrically conductive fiber braids are

carbon filaments.

20. A method for repairing a damaged section of a conduit comprising the steps of:

providing an elastomeric composite having a first and second end, wherein the composite includes a non-ferrous electrically conductive heating element comprising carbon fibers, graphite fibers, carbon filaments or graphite filaments and disposed within a thermoset resin matrix;

fixedly attaching a first and second end piece respectively to the first and second ends of the composite, wherein the first end piece, the second end piece, and the composite form a heating/inflation module;

removably attaching a pre-preg to an outer surface of the composite, wherein the pre-preg includes a structural fiber matrix supporting a heat curable resin;

positioning the module with the attached pre-preg into the conduit at a damaged location;

inflating the module to a predetermined internal air pressure to expand the composite and press the pre-preg against an inside surface of the conduit;

curing the resin of the pre-preg by causing an electrical current to flow in the heating element to resistively heat the module to a predetermined temperature; and

deflating the module and removing it from the conduit.

22. A system for in-situ repair of a conduit, comprising:

an apparatus including an elastomeric composite having a first end and a

second end, wherein the composite includes a non-ferrous heating element comprising carbon fibers, graphite fibers, carbon filaments or graphite filaments and disposed within a thermoset resin matrix;

a first end piece fixedly attached to the first end of the composite and having an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port to convey electric current to the non-ferrous heating element from a power supply source;

a second end piece fixedly attached to the second end of the composite, wherein the composite, the first end piece. and the second end piece form an inflation chamber; and,

a pre-preg removably attached to an outer surface of the composite of the apparatus, the pre-preg including a structural fiber matrix supporting a heat curable resin.

26. An inflatable heating device having a generally cylindrical body for internal in-situ repair of pipe shaped objects comprising:

an elastomeric seamless composite closed body having a generally cylindrical shape formed of at least one layer of a flexible elastomeric material having a first inner surface and a second outer surface, a plurality of nonmetallic, electrically conductive fibers comprising carbon fibers, graphite fibers, carbon filament or graphite filaments and located substantially throughout the length of the cylindrical shaped body between the first inner surface and second outer surface of the flexible elastomeric material;

at least one electrically conductive cable port connecting the electrically conductive fibers to an electrical power source; and

at least one air port for inflation and deflation of the closed body.

27. The inflatable heating device of Claim 26 wherein the generally cylindrical body has an outer diameter sized to allow the second outer surface to contact an inner surface of a repair object to transfer electrical resistive heat energy created by the conductive fibers located between the first inner surface layer and second outer surface layer when energized by the electrical power source and the body is inflated.

28. The inflatable heating device of Claim 26 further comprising components to monitor heat of the composite body and to control resistive heating.

APPENDIX OF EVIDENCE

A-1	Inflatable Heating Device Specification	
A-2	Inflatable Heating Device Drawings	
B	Examiner's Advisory Action	May 23, 2005
C	Examiner's Final Office Action	February 18, 2005
D	Hollingsworth	5,266,137
E	Japan '334 (Primary Reference)	
F	Japan '161	
G	Japan '323	
H	Wood et al.	5,706,861
I	Guenthner	5,216,085
J	Renaud	4,861,634
K	Baker et al.	4,191,383
L	Rankin	1,362,351
M	Lippiatt	5,199,462

EXHIBIT A-1

Serial No. 09/588,407

"Inflatable Heating Device"

Specification

(*Drawing are Exhibit A-2*)

Attorney Docket No. 240 P 028

PATENT

INFLATABLE HEATING DEVICE

DESCRIPTION

Technical Field

The present invention generally relates to an inflatable heating device and method of forming the device. More particularly, the invention relates to an inflatable heating device which can be inflated by a pressurized fluid and heated via an electrically conductive, non-ferrous matrix within the device's composition. The device can be used to provide compaction and heat sufficient to influence a physical reaction in a material in contact with the device's exterior, such as heating, compressing and curing a hardenable resin used in the in-situ repair of damaged conduits such as underground sewer pipes, and other structures having tubular or other three dimensional curvature.

Related U.S. Patent Application

This is a continuation-in-part of Application No. 08/882,769, filed June 26, 1997, which is a continuation-in-part of Application No. 08/431,302 filed April 28, 1995.

Background of the Invention

Use of composite materials in the repair of both accessible and inaccessible piping systems is becoming increasingly popular. The costs associated with replacing new conduits may be avoided or at least delayed by carrying out maintenance procedures at the damaged section of an on site or in-situ conduit. Generally, such maintenance procedures entail locating the damaged section and installing a thin, durable material to cover the defects, thus restoring the integrity of the conduit.

The materials and procedures employed in in-situ repair technology have been quite varied. Both low-cost, low-quality and high-cost, high-quality composites have

been developed. Most composites are designed as highly flexible materials in order to facilitate their transport to the damaged vicinity of the conduit. After transport, means are employed to conform the composite to the internal geometry of the damaged section. A reinforced lining impregnated with a resin covering the damaged section is then permanently cured to form a protective shell. The lining may be impregnated with resin on site or pre-impregnated at a remote location. The curing is accomplished either by ambient conditions or by positive heat-activation methods, such as hot water, steam, or electrical resistance heating. Ambient curing is inferior, however, because ambient conditions may vary widely and disrupt the curing cycle.

In the past, flexible heaters have been produced using ferrous or metallic wires within the composition to provide heat by resistive means. While these wires are an efficient heating element, the flexibility of the heater is limited by the use of such wires. For instance, in Japan 2158323 copper wires are used as the heating elements. With the repeated inflating and deflating that would be experienced with repeated use, it is expected that the redundant load paths associated with the flexing will cause the copper wires to fail, thus losing electrical continuity and heating capability. This severally limits the life cycle of a flexible heater manufactured with metallic wires. Copper wires disposed in a flexible composition also exhibit very poor adhesion to the surrounding polymer (usually silicon) making uniform and consistent positioning of the wires within the polymer matrix, throughout the expected life cycle of the heater, difficult if not impossible. This can result in the resistance wires being redistributed within the heater in undesired arrangements. While various primers can be employed to increase the bond strength between the polymer matrix and the wires, such primers can further degrade the flexible strength of the wire and limit its malleability, causing premature failure. Additionally, as copper or metallic wires are heated (resistively), their electrical resistance increases proportionately to the temperature increase. In a flexible heater, this means that the amount of power required to achieve a desired temperature must be increased throughout the heating cycle. The relatively high mass of copper or other electrically conductive metal, also

results in a lag in response time when used as a heating element, thus requiring constant monitoring and adjustment of the power supply.

Inflatable bladders that incorporate various heating means have also been used for curing materials impregnated with a thermosetting resin matrix, such as polyester or epoxy based resins. In these resin types, certain chemicals are present that have a detrimental effect on silicone products. Specifically, silicones, when exposed to certain chemicals such as styrene, which is present in many resin systems, and heat, will revert after a limited number of uses to into a weak form no longer suitable as an inflation device.

Historically, the actual production of flexible, inflatable heaters has been accomplished by various means. In one method, uncured strips of resin impregnated sheets of resilient, flexible material are laid on a mandrel or forming surface. The strips are then exposed to a heat source capable of providing sufficient heat to cure the uncured strips. Ovens have been used to accomplish this curing procedure. However, the ovens required are expensive and generally inefficient, as they must heat a large volume of air as well as the mandrel or forming surface, and the uncured strips. Depending on the mass of the mandrel, a substantial cool down period must also be observed before the heater can be removed from the mandrel. Considerable energy is lost to the atmosphere and cycle times are lengthy in such a procedure. This translates into excessively high manufacturing costs.

In view of the aforementioned shortcomings associated with the conventional methods of construction and use of flexible, inflatable heaters, there is a strong need for a inflatable heating device containing a heating mechanism that is robust. There is also a strong need for materials that can withstand repeated use in aggressive environments and afford a long life cycle. It will be appreciated that there is also a strong need for an improvement in manufacturing which can reduce production cycle time and capital equipment costs.

The present invention has been developed in response to a need for improved yet affordable composite materials for use as an inflatable flexible heater, as well as for a need for improved in-situ repair procedures.

Summary of the Invention

An object of one embodiment of the invention is to overcome the problems associated with flexible. inflatable heaters which incorporate metallic heating elements, and to provide a robust, inflatable heating device with an extended life cycle. Another object is to provide an inflatable heating device and process for manufacturing such devices which can reduce the cycle time in production and reduce the capital equipment costs associated with the production.

The apparatus of the present invention is generally characterized by a heating/inflation module having pressurizable interior and an attached heat curable pre-preg. In particular, an elastomeric, seamless composite is provided that includes a heating element disposed within a thermoset resin matrix. The composite is adapted to maintain a consistent temperature profile and an internal air pressure. A first end piece is attached to a first end of the composite and has an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port for communication with a power supply source. A second end piece attached to a second end of the composite. The apparatus further includes a pre-preg removably attached to an outer surface of the composite. The pre-preg includes a structural fiber matrix supporting a heat curable resin.

The composite is constructed by applying a liquid silicone matrix to at least one layer of braided fibers, wherein a portion of the fibers are electrically conductive. The layer of braided fibers is introduced into a mold, and a removable, expandable inner bladder is then loaded into the mold. The inner bladder is inflated to conform the layer of braided fibers to an interior surface of the mold. An electric current is caused to flow to the conductive fibers to cure the silicone matrix into a stable, elastomeric state. The finished composite is then removed from the mold.

A method for repairing a damaged section of a conduit is also disclosed. A pre-preg is removably attached to an outer surface of an elastomeric composite. The pre-preg and composite described herein may be used in this procedure. A

REPAIR MATERIAL

heater/inflation module is produced by providing first and second end pieces respectively attached to first and second ends of the composite. The module with the attached pre-preg is installed into the conduit at a damaged location. The module is then inflated to a predetermined internal air pressure to press the pre-preg against an inside surface of the conduit. The pre-preg resin is cured by causing an electrical current to flow in the heating element of the composite to resistively heat the module to a predetermined temperature. The electrical energy supply and thus the curing cycle may be controlled by conventional means such a programmable logic controller unit. Finally, the module is deflated such as by providing a vacuum source and removed from the conduit, leaving the permanently cured, resin impregnated liner to protect the damaged section of the conduit.

In another embodiment, the invention is an inflatable heating device comprising a generally cylindrical body having an inner surface and an outer surface. The body includes a flexible matrix and a plurality of carbon fibers embedded within the flexible matrix. The carbon fibers are arranged helically and positioned at an angle with respect to the longitudinal axis of the body, wherein the body is capable of expanding and returning to an original form.

The inflatable heating device can be a flexible matrix comprising fluorosilicone and fluorocarbon. The carbon fibers are preferably arranged at an angle of ±45° with respect to said longitudinal axis of said body and are arranged in tows or bundles to provide approximately 50-90% coverage of said body. The carbon fibers can also be in the form of a non-woven tape.

In another embodiment the invention comprises a process of forming an inflatable heating device comprising the steps of applying a layer of uncured sheets of a fluorosilicone material to a mandrel; winding a plurality of carbon fibers in a helix onto the fluorosilicone material layer; applying a layer of uncured sheets of fluorocarbon material over the carbon fibers; applying a radially inward pressure to said fluorosilicone layer, carbon fibers and fluorocarbon layer; and applying an electric current to said carbon fibers to resistively heat the carbon fibers to cure the fluorosilicone layer and the fluorocarbon layer to form a cured structure. The process

further comprises removing said electric current from said carbon fibers; removing the radially inward pressure from the fluorosilicone layer, carbon fibers and fluorocarbon layer; allowing the cured structure to cool; and removing the cured structure from said mandrel. Preferably, the applying an electric current step comprises resistively heating the carbon fibers to heat the fluorosilicone layer and the fluorocarbon layer to a temperature of approximately 300°F for approximately 45 minutes. Additionally, the process may comprise removing the fluorosilicone layer, carbon fibers and fluorocarbon layer from the mandrel, and heating the fluorosilicone layer, carbon fibers and fluorocarbon layer to a temperature greater than 300°F. The process may also include incorporating a layer of uncured silicon sheets in the cured structure.

Other features and advantages of the invention will be apparent from the following specification taken in conjunction with the following drawings.

Brief Description of the Drawings

Figure 1 is a cross-sectional view of the composite of the present invention;

Figure 2 is a side view of the composite of the present invention installed into a molding apparatus;

Figure 3 is a partial cut-away view showing the heating/inflation module of the present invention installed within a conduit to be repaired;

Figure 4 is a cross-sectional view of the front portion of the heating/inflation module of the present invention;

Figure 5 is a side view of the front portion of the heating/inflation module of the present invention showing the conductive and sealing bands;

Figure 6 is a perspective view of the inflatable heater device of the present invention with a cut-out portion;

Figure 7 is a side view of the inflatable heater device of the present invention installed into a molding apparatus;

Figure 8 is a partial cut-away view showing the inflatable heating device or module of the present invention installed within a conduit to be repaired;

Figure 9 is an exploded cross-sectional view of a end portion of the inflatable heating device of the present invention; and,

Figure 10 is a side view of the end portion shown in Figure 9.

Detailed Description of the Preferred Embodiment

While this invention is susceptible of embodiments in many different forms, there is shown in the drawings and will herein be described in detail preferred embodiments of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the broad aspect of the invention to the embodiments illustrated.

Figure 1 cross-sectionally illustrates one embodiment of the composite 205 in accordance with the present invention. The composite 205 is inflatable or elastomeric, seamless, reinforced with structural braids 201, and for most applications generally cylindrical. The composite 205 is a single layer formed from one or more initially discrete layers that are consolidated by means of a thermoset resin 202. The resin 202 is preferably a silicone matrix such as methylvinylpolysiloxane, which will remain flexible after its application and cure. The core of the composite 205 contains a heating element 201 defined by conductive braided fibers. The heating element 201 is used both to cure the actual composite lay-up, and subsequently to cure a separate heat activated resin matrix of the pre-preg as described below.

With reference to Figure 2, the silicone matrix 202 used in the construction of the composite 205 is initially a pourable liquid, heat curable methylvinylpolysiloxane or other material having similar properties. The composite 205 is formed by applying the liquid silicone matrix 202 to pre-formed, braided composite fibers shown partially at 201. At least a portion of the fibers 201 should be conductive. Graphite fibers have been found suitable for this purpose. For additional structural support, the composite fibers 201 may comprise a combination of graphite and fiberglass braids. The exact ratio of graphite to glass used will depend on the amount of structural strength contemplated as well as the heat generation capability desired. A composite found suitable for the present application consists of biaxial fiberglass braided sleeving with

a weight of 10-20 oz./sq. yd. and biaxial carbon braided sleeving with a weight of 15-30 oz./sq. yd. The braid angle of these components is preferably +/- 45 degrees. It will be understood that other high-strength, temperature tolerant fiber braids may be substituted for the fiberglass and other electrically conductive fiber braids may likewise be substituted for the graphite. For example, conductive polymer coated nylon or polyester fiber, or a combination of many different conductive fiber braids may be used instead of graphite.

The silicone matrix 202 having been applied and having saturated the heating element layer 201, the composite 205 is then placed in a mold 501 having the desired dimensions and configuration (e.g., cylindrical). The mold 501 shown in Figure 2 has a typical clam-shell design. An expandable inner bladder or forming mandrel 504 is positioned within the interior space defined by the composite 205, and inflated to conform the composite 205 to the internal shape of the mold 501. Electric current is applied to the conductive braids 201, generating heat sufficient to cause the silicone matrix 202 to irreversibly cure into a flexible or elastomeric state. Front and rear end pieces 6,8 are also permanently molded to the composite 205 during the molding process. Once the matrix 202 has cured, the composite 205 is allowed to cool and is then removed from the mold 501. Note that the inner bladder 504 is only used during the molding process and must be removed from the cured composite 205.

While a single layer of composite material may be cured in this fashion, multiple discrete layers may be used for added thickness and strength. The cured silicone also acts to mechanically consolidate these multiple layers as well as the fiberglass and graphite braids themselves. This process essentially creates a monolithic membrane, preferably having a finished thickness of 60-75 mils, or 0.125 to 0.250 inches. Silicone and fluoropolymer compounds have been preferably selected as the resin material for the composite due to their inherent anti-stick properties. These properties enable the cured pre-preg pipe repair material, described below, to be easily removed from the composite 205 during the in-situ repair process, also described below. The finished composite 205 is strong yet elastomeric and is

capable of expanding within a damaged pipe 1 to conform to irregular surfaces therein.

Figures 3-5 show the elastomeric composite 205 integrated into a heater/inflation module 210. The module 210 includes front and rear end pieces 6,8 to effectively seal the interior of the composite 205. Thus, the front and rear end pieces 6,8 are permanently attached to the front and rear ends of the composite 205 and sealed by sealing means 112, 101. The front end piece 6 includes an air line 7, a vacuum line 10, and one or more electrical cable lines (not shown) within an electrical conduit 11. These lines 7,10,11 respectively provide communication to an air compressor, vacuum supply source and electrical energy source (not shown) used in the in-situ repair method described below.

In the embodiment shown in Figures 4 and 5, the front end piece 6 (as well as the rear end piece 8) includes a metallic contacting band 103 and a sealing mechanism sealing bands 101. The bands 101,103 may be constructed of type 201 stainless steel having ½ inch width. As shown in Figure 5, the bands 101,103 may be secured to the composite 205 by conventional means such as type 301 stainless steel set screw buckles 112. The end pieces 6,8 are constructed from cast or machined aluminum or a fiber-reinforced, high-temperature plastic material. The end pieces 6,8 also have at least one circumferential groove 113 serving as a mechanical attachment point between the composite 205 and the end pieces 6,8 and to increase the sealing surface area. The metallic bands 103 ensure electrical continuity and the transfer of electrical energy to the conductive heating core 201 of the composite 205. As preferably shown in Figure 4, an electrical input line within electrical conduit 11 leads through the front end piece 6 to the conductive metallic band 103 and is connected thereto by an internal terminal 106. An electrical output line 12 enters through the front end piece 6, runs longitudinally through the inflation chamber 102, and contacts the heating element layer 201 at the rear end piece 8 to complete the resistive heating circuit. This arrangement effectively creates a circuit for electrical energy to pass through the entire composite 205 while only requiring external electrical connections at one end piece.

A pre-preg 3 is removably attached to the outer surface of the composite 205 by conventional means, such as rubber bands, sewing, or adhesive. The pre-preg 3 is generally defined as a fibrous fabric reinforcement impregnated with a liquid, heat curable resin. The resin may be an epoxy, a cyanate ester, polyester, a vinyl ester, a polyurethane, or a blend of these and other materials having similar characteristics. One type of pre-preg found suitable is prepared from a glass fiber matrix saturated with an isopolyester resin base catalyzed with 1% by weight perkadox 16 organic peroxide percarbonate, available from Akzo Chemicals, and with 1% by weight trigonox 29-B75 organic peroxide, also available from Akzo Chemicals. This catalyzed material constitutes an A-staged pre-preg having a shelf-life of 7-9 days. For the present application, it is preferable that the resin be capable of exotherming in the range of 180 °F to 400 °F. The term "exotherm" refers to the temperature to which the resin will rise upon initiation of chemical cross-linking during the curing process.

It has also been found beneficial to chemically thicken the pre-preg resin to a gelled state by adding a urethane additive such as Reichhold RD 1070 to the resin before the resin has been applied to the structural fiber matrix of the pre-preg. This thickening process converts the liquid resin into an immobile, non-migratory state, ensures that the resin matrix will not be affected by diverse environmental variables such as moisture, ensures a consistent liner thickness, and increases shelf life.

In operation, the heater/inflation module 210 with the attached pre-preg 3 is transported to the damaged section 2 of the pipe 1. Transportation may be accomplished by using winches (not shown) or other known equipment. For instance, Figure 3 shows a front winch cable 9 attached to a front winch pull 105 on the front end piece 6, and a rear winch cable 5 is likewise attached to the rear end piece 8. The winch cables 5,9 run to the ground surface via supply chutes and manholes (not shown). Invert rollers (not shown) may be used to facilitate movement of the cables 5,9.

Once the module 210 is in place, an air compressor (not shown) is engaged to direct air into the interior or inflation chamber 102 of the module 210 through its air

line 7. The module 210 is brought to a predetermined pressure to expand the composite 205 within the pipe 1. Consequently, the pre-preg 3 is forced against the interior surface of the pipe section 2 and thus conforms to the internal shape of the pipe 1. Electrical current is then flowed from a remote power source (not shown) through the one or more electrical cables 11 to resistively heat the module 210. As noted earlier, the temperature profile exhibited by the module 210 will depend upon the location and density of the conductive fiber braids 201 of the composite 205. The heat given off by the module 210 is maintained to permit the pre-preg resin to exotherm and thus activate the curing phase. Once the pre-preg 3 has fully cured against the damaged pipe section 2, the module 210 is deflated by engaging a remote vacuum source (not shown) to draw a vacuum through the vacuum line 10. The module 210 may then by removed from the repaired pipe 1.

It will be understood that a closed-loop programmable logic controller may be employed to monitor and vary both the internal air pressure and the temperature profile of the module during the repair operation. The controller or similar means may thus assist in achieving a uniform cure despite varying conditions.

The materials used to construct the inflatable heating device or module 210 can be critical with respect to the final operation of the module in certain instances. That is, the intended use and the environmental conditions need to be considered in the material selection. For example, if the module 210 is to be employed in a pipe repair procedure wherein the module is required to carry a pre-preg 3 to a designated area of repair, to inflate to a pre-determined diameter, apply a specific force to the repair material, and to provide a uniform temperature profile across the entire surface of the pre-preg 3, the materials selected to construct the module 210 must be suitable for all of these operations.

Another embodiment of an inflatable heating device or module 210 of the present invention is disclosed in Figures 6-10.

In the present invention, multiple compositions can be considered and formed into the module using the resistive heat generating capability of carbon fibers in the module itself. A rotating mandrel can be provided as the forming surface of the

composite 205. If the module is to be used for a pipe repair procedure, the mandrel would be generally cylindrical in shape and have a diameter closely approximating the inside diameter of the pipe to be repaired (minus the thickness of the module materials and allowing for 10-15% expansion of the module). A fluorosilicone material is utilized as an internal surface due to its inherent impermeability and low vapor transmission properties. The heating grid of the module is preferably a non-ferrous material, and is more preferably constructed of carbon fibers. Carbon fibers, with their exceptional tensile strength, electrical conductivity and chemical inertness, are used as both the heat producing element and the reinforcement for the module 210. An outer layer of a fluorocarbon could also be used to protect and contain the carbon fibers as well as providing a highly resistant (both chemically and thermally) and resilient outer skin. Because of the fluoropolymer similarities, during the consolidation and forming on the mandrel, the uncured flourosilicone and fluorocarbon materials are co-cured and bonded together to form a homogenous mass capable of resisting chemicals, abrasion and heat while maintaining flexibility.

The carbon fibers, when wound in a generally circumferential fashion around the mandrel in a helix formation, can be placed at an angle relative to the longitudinal axis of the mandrel (and thus to the completed module). This angle can be pre-selected and controlled during the production of the module in order to limit the amount of expansion of the completed module 210, while providing the necessary support to the fluorosilicone/fluorocarbon matrix. Winding the carbon fibers in a helix allows for circumferential expansion and provides electrical continuity from one end to an opposing end of the module 210. By orienting the carbon fibers at an angle of $\pm 45°$ in relation to the longitudinal axis of the module 210, a degree of expansion can be assumed without undue stress on the fibers. As pressure is applied to the internal portion of the module 210 (in operation), as with air pressure, the module 210 can expand radially as the fiber angle changes from the 45° up to an angle approaching 56°, where the fibers essentially lock and restrict any further expansion effectively rigidizing the structure. Carbon fibers are traditionally chosen for various products due to their strength and therefore eliminate the need for additional

reinforcement. Because of the high strength of carbon fiber, this action (i.e., expansion) can be performed repeatedly with minimal effect on the module 210, thus ensuring an exceptional life cycle.

With appropriate electrical contacts to communicate an electric current to the carbon fibers disposed within the module 210, the carbon fibers can be used as heating elements capable of generating temperatures in excess of 500°F without fear of degradation. During the fabrication of the module 210, the carbon fibers are introduced to the uncured fluoropolymers in a fibrous state. The uncured materials, being soft and with a very low durometer in this state, readily accept the carbon fibers, effectively encapsulating and bonding the fibers to the matrix.

According to another aspect of the invention, the carbon fibers used as the reinforcement and a means for generating heat in the finished module 210, can be used provide heat to cure the components of the module itself during its manufacture. With the desired lay-up of materials for the module complete, conventional methods are used to consolidate the materials prior to curing, such as wrapping with release tape or web under pressure, enveloping the entire assembly with a membrane or film and drawing vacuum, or applying a layer of film, that when heated, will shrink and provide compaction. Traditionally, the entire mandrel and composition of the inflatable heater would then be relocated to a curing oven. In the present invention, the carbon fibers are captured at each end and an electric current is introduced. Carbon fibers, being low in mass and with a known conductivity, will rapidly produce heat in a uniform manner. Because the electrical properties of carbon can be readily assumed, precise and uniform heating can be achieved. Also, because the heat source is within the composition of the module, cycle times can be dramatically reduced and excess heat generation is minimized. Energy consumption is far less than traditional methods. This can all be accomplished with the use of an inexpensive power supply as compared to costly ovens. Because the cure cycle is markedly faster than with an oven or the like, heat transfer to the mandrel is reduced therefor providing quicker cool-down an subsequent part removal.

While the specific embodiment has been illustrated and described, numerous modifications come to mind without significantly departing from the spirit of the invention, and the scope of protection is only limited by the scope of the accompanying Claims.

ABSTRACT OF THE DISCLOSURE

The apparatus of the present invention is generally characterized by a heating/inflation module having pressurizable interior and an attached heat curable pre-preg. In particular, an elastomeric, seamless composite is provided that includes a heating element disposed within a thermoset resin matrix. The composite adapted to maintain a consistent temperature profile and an internal air pressure. A first end piece is attached to a first end of the composite and has an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port for communication with a power supply source. A second end piece attached to a second end of the composite. The apparatus further includes a pre-preg removably attached to an outer surface of the composite. The pre-preg includes a structural fiber matrix supporting a heat curable resin. The composite is constructed by applying a liquid silicone matrix to at least one layer of braided or wound and/or tape fibers, wherein a portion of the fibers are electrically conductive. The layer of braided fibers is introduced into a mold, and a removable, expandable inner bladder is then loaded into the mold. The inner bladder is inflated to conform the layer of braided fibers to an interior surface of the mold. An electric current is caused to flow to the conductive fibers to cure the silicone matrix into a stable, elastomeric state. The composite is removed from the mold. A method for repairing a damaged section of a conduit is also disclosed.

Additionally, in another embodiment of the invention an inflatable heater is disclosed which includes a non-metallic heating stratum or element inextricably located within a fluorosilicone, silicone and fluorocarbon matrix. The inflatable heater is made by wrapping uncured sheets of material about a mandrel and including a non-metallic heating stratum, such as carbon fibers. The described matrix utilizes resistive heat from the heating stratum to cure into a final resilient form. The carbon fibers are arranged in a fashion to allow flexibility and durability in the final form.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO. 09/588,407 § ATTY DOCKET NO. 72537.93800

INVENTOR: **Richard D. Blackmore** § EXAMINER: **Steven D. Maki**

TITLE: **INFLATABLE HEATING DEVICE** § GROUP ART UNIT: **1733**

FILING DATE: **June 6, 2000** §

Box RESPONSES—FEE
Assistant Commissioner for Patents
United States Patent and Trademark Office
Washington, D.C. 20231

Sir:

AMENDMENT

Applicant hereby timely responds to the Office Action dated March 19, 2002. Please amend the above-identified application as follows:

In the Specification:

At page 2, line 10, please amend the paragraph beginning with "In the past" (which continues to page 3, line 2) to read as follows:

a1

In the past, flexible heaters have been produced using ferrous or metallic wires within the composition to provide heat by resistive means. While these wires are an efficient heating element, the flexibility of the heater is limited by the use of such wires. For instance, in Japan 2158323 copper wires are used as the heating elements. With the repeated inflating and deflating that would be experienced with repeated use, it is expected that the redundant load paths associated with the flexing will cause the copper wires to fail, thus losing electrical continuity and heating capability. This severely limits the life cycle of a flexible heater manufactured with metallic wires. Copper wires disposed in a flexible composition also exhibit very poor adhesion to the surrounding polymer (usually silicon) making uniform and consistent positioning of the wires within the polymer matrix, throughout the expected life cycle of the heater, difficult if not impossible. This can result in the resistance wires being redistributed within the heater in undesired arrangements. While various primers can be employed to

09/24/2002 WABDELR1 00000048 09588407
01 FC:202 42.00 OP

09/24/2002 WABDELR1 00000047 09588407
02 FC:203 9.00 OP

Q1

increase the bond strength between the polymer matrix and the wires, such primers can further degrade the flexible strength of the wire and limit its malleability, causing premature failure. Additionally, as copper or metallic wires are heated (resistively), their electrical resistance increases proportionately to the temperature increase. In a flexible heater, this means that the amount of power required to achieve a desired temperature must be increased throughout the heating cycle. The relatively high mass of copper or other electrically conductive metal also results in a lag in response time when used as a heating element, thus requiring constant monitoring and adjustment of the power supply.

At page 3, line 3, please amend the paragraph beginning with "Inflatable bladders" to read as follows:

Q2

Inflatable bladders that incorporate various heating means have also been used for curing materials impregnated with a thermosetting resin matrix, such as polyester or epoxy based resins. In these resin types, certain chemicals are present that have a detrimental effect on silicone products. Specifically, silicones, when exposed to certain chemicals such as styrene, which is present in many resin systems, and heat, will revert after a limited number of uses into a weak form no longer suitable as an inflation device.

At page 3, line 21, please amend the paragraph beginning with "In view of" to read as follows:

Q3

In view of the aforementioned shortcomings associated with the conventional methods of construction and use of flexible, inflatable heaters, there is a strong need for an inflatable heating device containing a heating mechanism that is robust. There is also a strong need for materials that can withstand repeated use in aggressive environments and afford a long life cycle. It will be appreciated that there is also a strong need for an improvement in manufacturing which can reduce production cycle time and capital equipment costs.

At page 4, line 9, please amend the paragraph beginning with "The apparatus" to read as follows:

Q4

The apparatus of the present invention is generally characterized by a heating/inflation module having a pressurizable interior and a removably attached heat curable pre-preg. In particular, an elastomeric, seamless composite is provided that includes a heating element disposed within a thermoset resin matrix. The composite is adapted to maintain a consistent temperature profile and an internal air pressure. A first end piece is attached to a first end of the composite and has an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port for communication with a power supply source. A second end piece is attached to a second end of the composite. The apparatus further includes a pre-

a4 preg removably attached to an outer surface of the composite. The pre-preg includes a structural fiber matrix supporting a heat curable resin.

At page 4, line 28, please amend the paragraph beginning with "A method" (which continues to page 5, line 11) to read as follows:

a5 A method for repairing a damaged section of a conduit is also disclosed. A pre-preg is removably attached to an outer surface of an elastomeric composite. The pre-preg and composite described herein may be used in this procedure. A heater/inflation module is produced by providing first and second end pieces respectively attached to first and second ends of the composite. The module with the attached pre-preg is installed into the conduit at a damaged location. The module is then inflated to a predetermined internal air pressure to press the pre-preg against an inside surface of the conduit. The pre-preg resin is cured by causing an electrical current to flow in the heating element of the composite to resistively heat the module to a predetermined temperature. The electrical energy supply and thus the curing cycle may be controlled by conventional means such as a programmable logic controller unit. Finally, the module is deflated such as by providing a vacuum source and removed from the conduit, leaving the permanently cured, resin impregnated liner to protect the damaged section of the conduit.

At page 7, line 1, please amend the paragraph beginning with "Figure 9" to read as follows:

a6 Figure 9 is an exploded cross-sectional view of an end portion of the inflatable heating device of the present invention; and

At page 10, line 29, please amend the paragraph beginning with "Once" (which continues to page 11, line 12) to read as follows:

a7 Once the module 210 is in place, an air compressor (not shown) is engaged to direct air into the interior or inflation chamber 102 of the module 210 through its air line 7. The module 210 is brought to a predetermined pressure to expand the composite 205 within the pipe 1. Consequently, the pre-preg 3 is forced against the interior surface of the pipe section 2 and thus conforms to the internal shape of the pipe 1. Electrical current is then flowed from a remote power source (not shown) through the one or more electrical cables 11 to resistively heat the module 210. As noted earlier, the temperature profile exhibited by the module 210 will depend upon the location and density of the conductive fiber braids 201 of the composite 205. The heat given off by the module 210 is maintained to permit the pre-preg resin to exotherm and thus activate the curing phase. Once the pre-preg 3 has fully cured against the damaged pipe section 2, the module 210 is deflated by engaging a remote vacuum source (not shown) to draw a vacuum

a7

through the vacuum line 10. The module 210 may then be removed from the repaired pipe 1.

At page 13, line 11, please amend the paragraph beginning with "According" to read as follows:

a8

According to another aspect of the invention, the carbon fibers used as the reinforcement and a means for generating heat in the finished module 210 can be used to provide heat to cure the components of the module itself during its manufacture. With the desired lay-up of materials for the module complete, conventional methods are used to consolidate the materials prior to curing, such as wrapping with release tape or web under pressure, enveloping the entire assembly with a membrane or film and drawing a vacuum, or applying a layer of film that, when heated, will shrink and provide compaction. Traditionally, the entire mandrel and composition of the inflatable heater would then be relocated to a curing oven. In the present invention, the carbon fibers are captured at each end and an electric current is introduced. Carbon fibers, being low in mass and with a known conductivity, will rapidly produce heat in a uniform manner. Because the electrical properties of carbon can be readily assumed, precise and uniform heating can be achieved. Also, because the heat source is within the composition of the module, cycle times can be dramatically reduced and excess heat generation is minimized. Energy consumption is far less than traditional methods. This can all be accomplished with the use of an inexpensive power supply as compared to costly ovens. Because the cure cycle is markedly faster than with an oven or the like, heat transfer to the mandrel is reduced thereby providing quicker cool-down and subsequent part removal.

PTO/SB/21 (09-04)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission: 15

Application Number	09/588,407
Filing Date	June 6, 2000
First Named Inventor	Richard Blackmore
Art Unit	1733
Examiner Name	Steven Maki
Attorney Docket Number	P-028

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☑ Amendment/Reply
  - ☑ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
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Remarks

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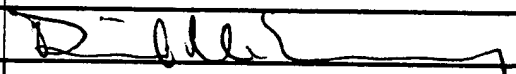
Firm Name	Law Office of David McEwing PC		
Signature			
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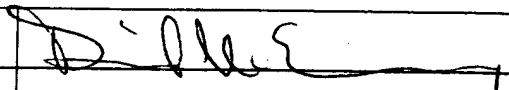
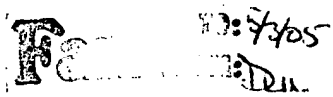
Date	May 3, 2005	Reg. No.	37,026

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature			
Typed or printed name	David McEwing	Date	May 3, 2005



REPLY UNDER 37 CFR 1.116-EXPEDITED PROCEDURE

TECHNOLOGY CENTER 1733

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT EXAMINING OPERATION

Applicant:	§	
Richard Blackmore et al.	§	Group Art Unit: 1733
	§	
Serial No. 09/588,407	§	Examiner: Steven P. Maki
	§	
Filed: June 6, 2000	§	Atty. Dkt. No.: 240-P-028
	§	
Confirmation No. 9445	§	

For: Inflatable Heating Device

AMENDMENT AFTER FINAL REJECTION

Honorable Commissioner of Patents and Trademarks
Alexandria, Virginia

SIR:

This paper is presented as a revised proposed amendment in accordance with 37 CFR §1.116 and MPEP §714.12. Admission is urged for the reasons that the proposed amendment (i) adopts changes to the specification intended to overcome objections properly noted by the Examiner and (ii) places the claims in better form for appeal. Comments of the Examiner mailed April 29, 2005 have been addressed. Consideration of the proposed amendment is requested.

AMENDMENT TO THE SPECIFICATION

With respect to the Examiner's previous comments, the continuing data is inserted as the first sentence.

INFLATABLE HEATING DEVICE

Related U.S. Patent Application

This is a continuation-in-part of Application No. 08/882,769, filed June 26, 1997, which is a continuation-in-part of Application No. 08/431,302 filed April 28, 1995.

Technical Field

The present invention generally relates to an inflatable heating device and method of forming the device. More particularly, the invention relates to an inflatable heating device which can be inflated by a pressurized fluid and heated via an electrically conductive, non-ferrous matrix within the device's composition. The device can be used to provide compaction and heat sufficient to influence a physical reaction in a material in contact with the device's exterior, such as heating, compressing and curing a hardenable resin used in the in-situ repair of damaged conduits such as underground sewer pipes, and other structures having tubular or other three dimensional curvature.

~~Related U.S. Patent Application~~

~~This is a continuation-in-part of Application No. 08/882,769, filed June 26, 1997, which is a continuation-in-part of Application No. 08/431,302 filed April 28, 1995.~~

With respect to the Examiner's previous comments, the specification is amended to provide a proper antecedent basis for Claim 18. The previous proposed reference to non-conductive fibers has been omitted. The paragraph beginning at line 28 of page 11 is amended as follows:

In the present invention, multiple compositions can be considered and formed into the module using the resistive heat generating capability of carbon fibers in the module itself. A rotating mandrel can be provided as the forming surface of the composite 205. If the module is to be used for a pipe repair procedure, the mandrel would be generally cylindrical in shape and have a diameter closely approximating the inside diameter of the pipe to be repaired (minus the thickness of the module materials and allowing for 10-15% expansion of the module). A fluorosilicone material is utilized as an internal surface due to its inherent impermeability and low vapor transmission properties. The heating grid of the module is preferably a non-ferrous material, and is more preferably constructed of carbon fibers. Carbon fibers, with their exceptional tensile strength, electrical conductivity and chemical inertness, are used as both the heat producing element and the reinforcement for the module 210. <u>The heating element can include a plurality of wound fibers comprising of temperature tolerant fiber windings and electrically conductive, i.e., carbon fiber, windings.</u> An outer layer of a fluorocarbon could also be used to protect and contain the carbon fibers as well as providing a highly resistant (both chemically and thermally) and resilient outer skin. Because of the fluoropolymer similarities, during the consolidation and forming on the mandrel, the uncured flourosilicone and fluorocarbon materials are co-cured and bonded together to form a homogenous mass capable of resisting chemicals, abrasion and heat while maintaining flexibility.

In response to the Examiner's previous comments that the non-ferrous heating element being carbon filaments or graphite filaments, the paragraph beginning at line 21 of page 7 is amended as follows (repeating two sentences originally appearing at line 21 of page 13 of the original disclosure):

With reference to Figure 2, the silicone matrix 202 used in the construction of the composite 205 is initially a pourable liquid, heat curable methylvinylpolysiloxane or other material having similar properties. The composite 205 is formed by applying the liquid silicone matrix 202 to pre-formed, braided composite fibers shown partially at 201. At least a portion of the fibers 201 should be conductive. Graphite fibers have been found suitable for this purpose. Carbon fibers, being low in mass and with a known conductivity will rapidly produce heat in a uniform manner Because the electrical properties of carbon can be readily assumed, precise and uniform heating can be achieved. The non-ferrous heating element may therefore be of carbon or graphite filaments. For additional structural support, the composite fibers 201 may comprise a combination of graphite and fiberglass braids. The exact ratio of graphite to glass used will depend on the amount of structural strength contemplated as well as the heat generation capability desired. A composite found suitable for the present application consists of biaxial fiberglass braided sleeving with a weight of 1 0-20 oz./sq. yd. and biaxial carbon braided sleeving with a weight of 15-30 oz./sq. yd. The braid angle of these components is preferably +/- 45 degrees. It will be understood that other high-strength, temperature tolerant fiber braids may be substituted for the fiberglass and other electrically conductive fiber braids may likewise be substituted for the graphite. For example, conductive polymer coated nylon or polyester fiber, or a combination of many different conductive fiber braids may be used instead of graphite.

In further response to the Examiner's comment, the abstract is shortened and amended to read as follows:

ABSTRACT OF THE DISCLOSURE

The apparatus of the present invention is generally characterized by a heating/inflation module having pressurizable interior and an attached heat curable pre-preg. In particular, an elastomeric, seamless composite is provided that includes a heating element disposed within a thermoset resin matrix. The composite adapted to maintain a consistent temperature profile and an internal air pressure. A first end piece is attached to a first end of the composite and has an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port for communication with a power supply source. A second end piece attached to a second end of the composite. The apparatus further includes a pre-preg removably attached to an outer surface of the composite. The pre-preg includes a structural fiber matrix supporting a heat curable resin. The composite is constructed by applying a liquid silicone matrix to at least one layer of braided or wound and/or tape fibers, wherein a portion of the fibers are electrically conductive. The layer of braided fibers is introduced into a mold, and a removable, expandable inner bladder is then loaded into the mold. The inner bladder is inflated to conform the layer of braided fibers to an interior surface of the mold. An electric current is caused to flow to the conductive fibers to cure the silicone matrix into a stable, elastomeric state. The composite is removed from the mold. A method for repairing a damaged section of a conduit is also disclosed.

~~Additionally, in another embodiment of the invention an inflatable heater is disclosed which includes a non-metallic heating stratum or element inextricably located within a fluorosilicone, silicone and~~

~~fluorocarbon matrix. The inflatable heater is made by wrapping uncured sheets of material about a mandrel and including a non-metallic heating stratum, such as carbon fibers. The described matrix utilizes resistive heat from the heating stratum to cure into a final resilient form. The carbon fibers are arranged in a fashion to allow flexibility and durability in the final form.~~

EXHIBIT A-2

Serial No. 09/588,407

"Inflatable Heating Device"

DRAWINGS

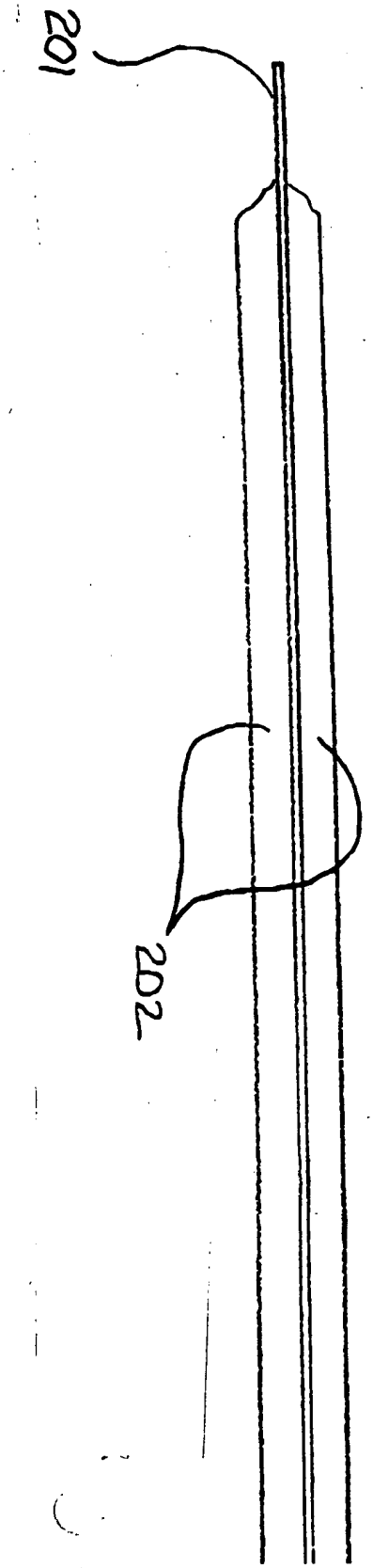


FIG 1

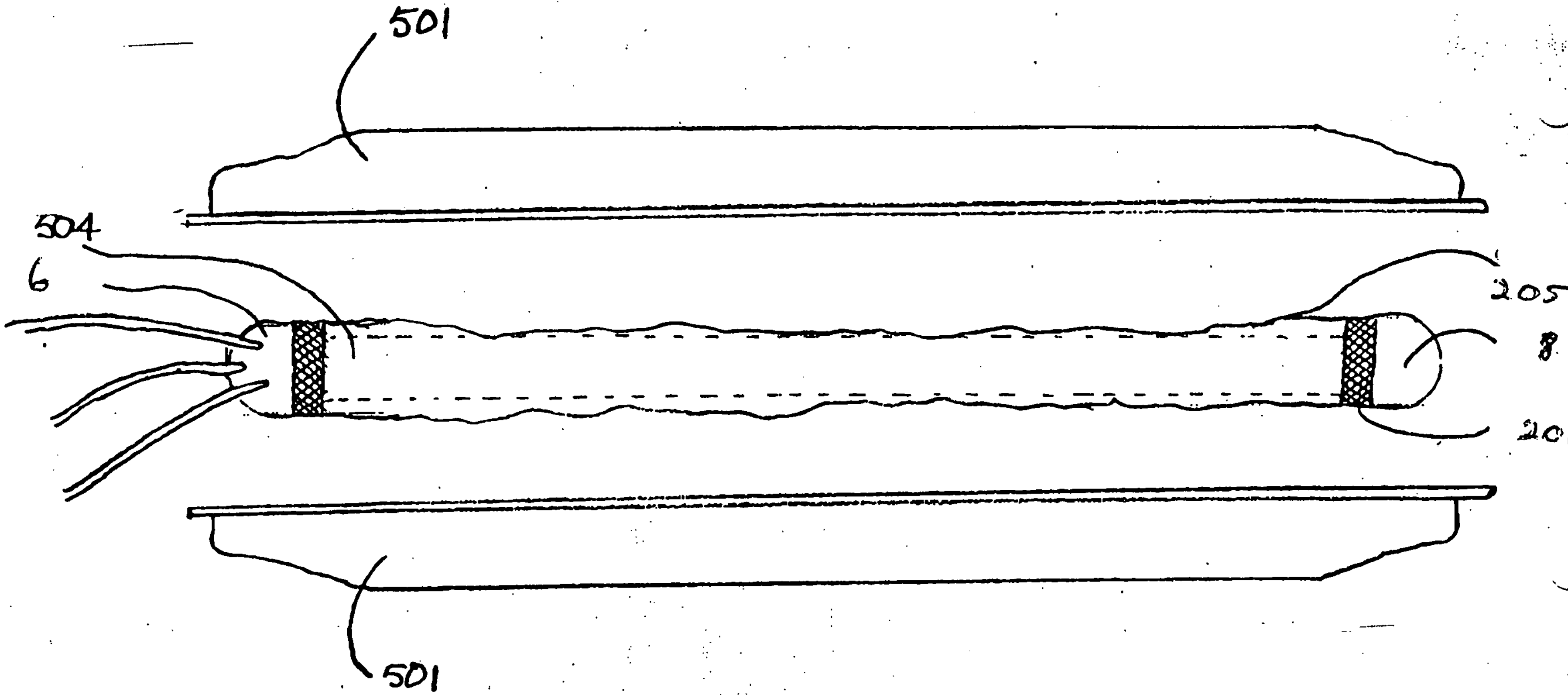


FIG 2

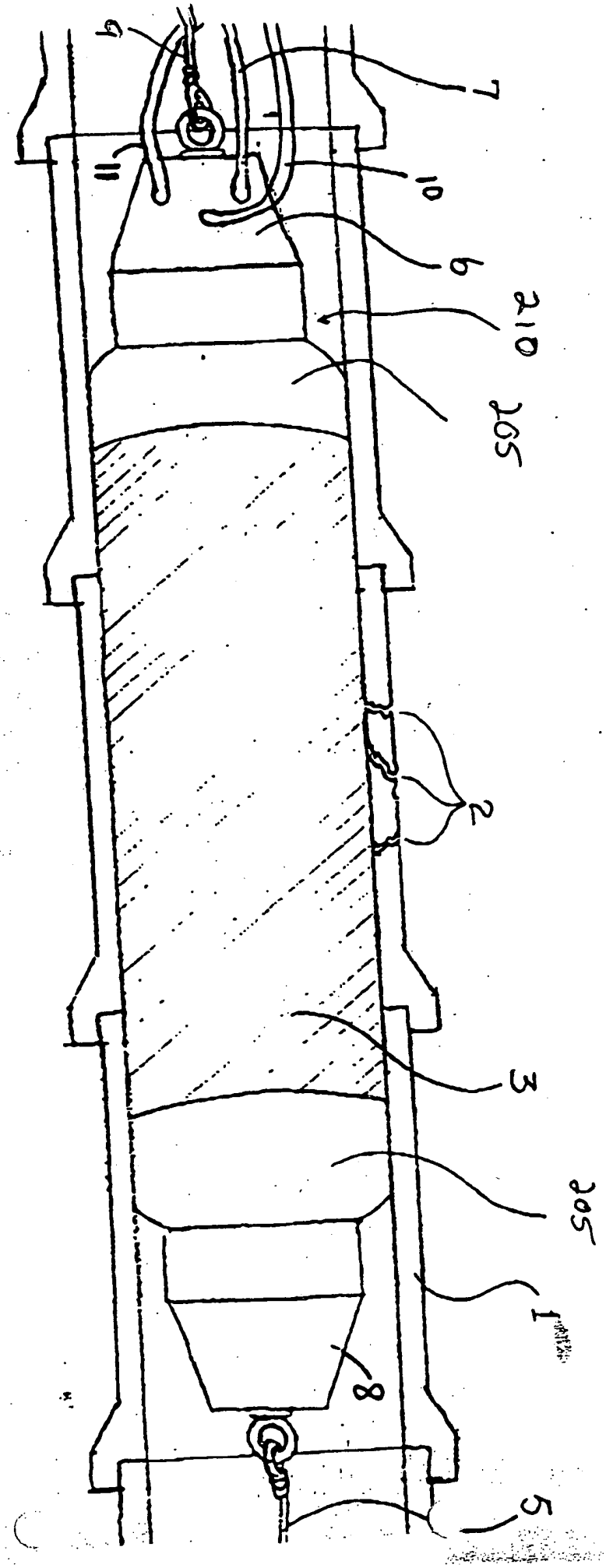


FIG 3

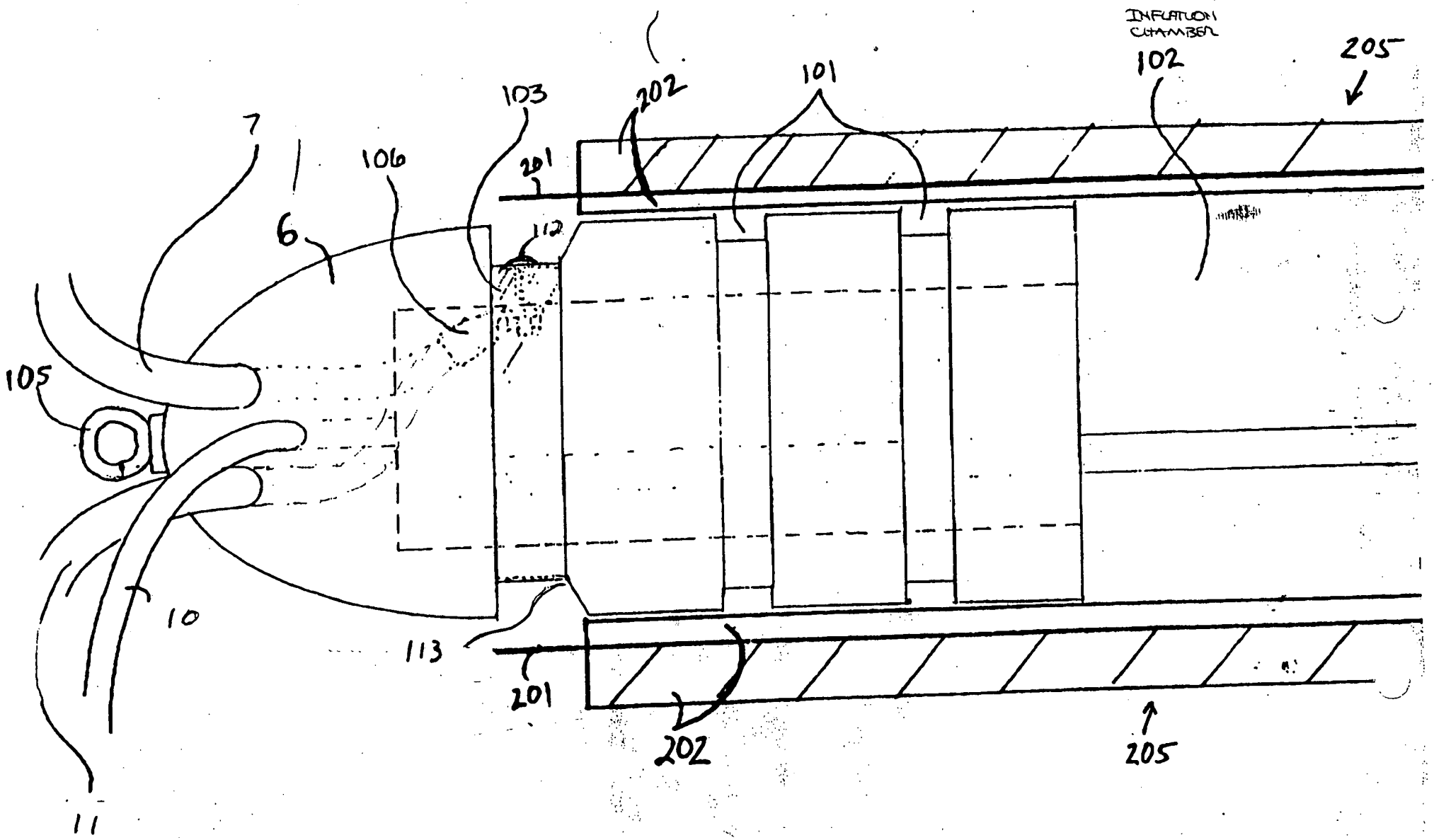


FIG 4

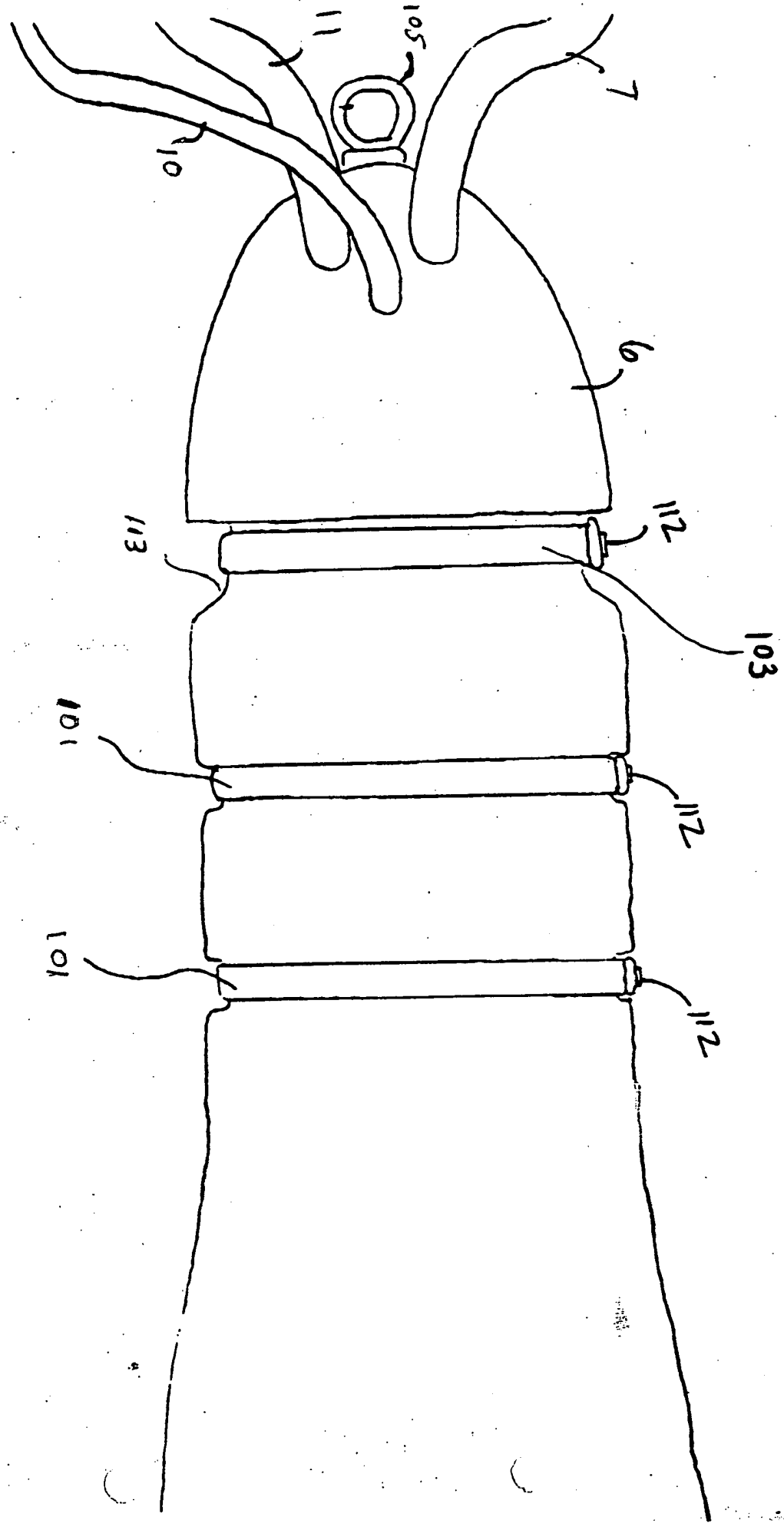


FIG 5

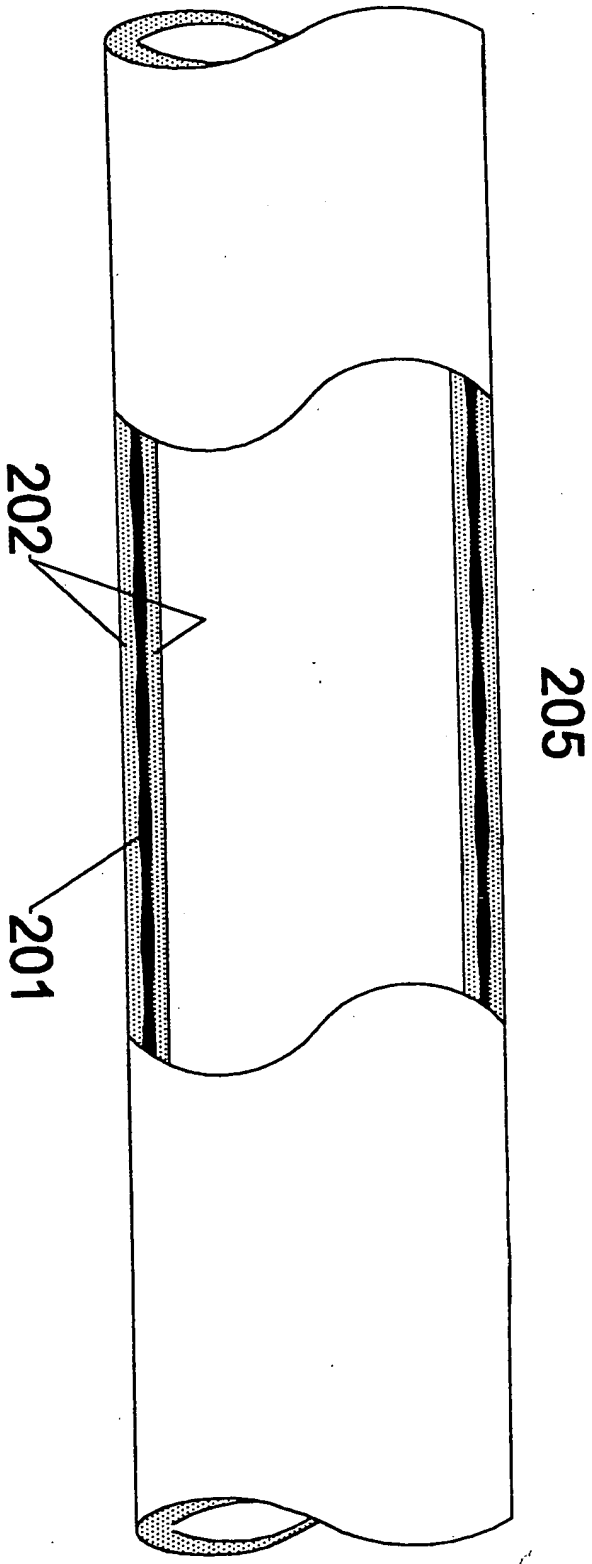


FIG. 6

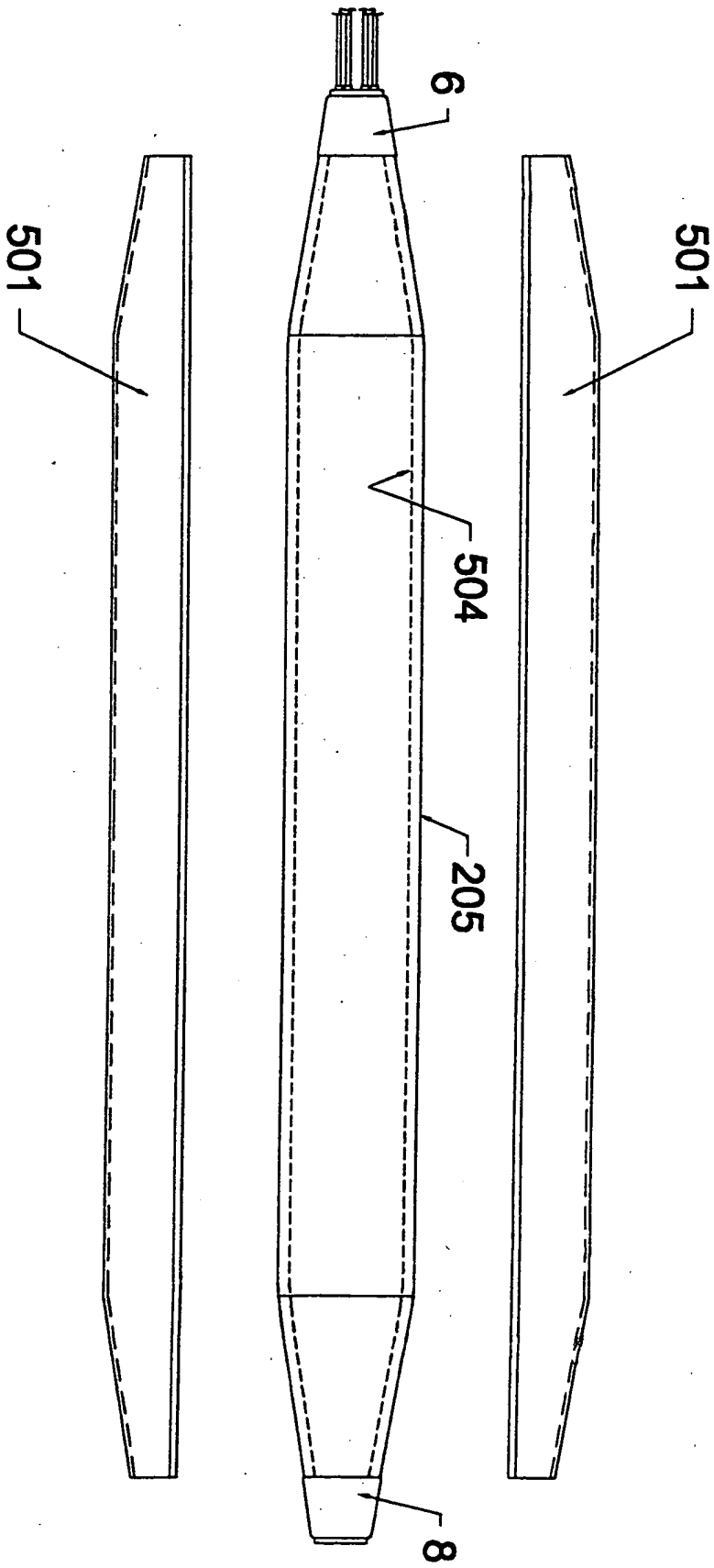


FIG. 7

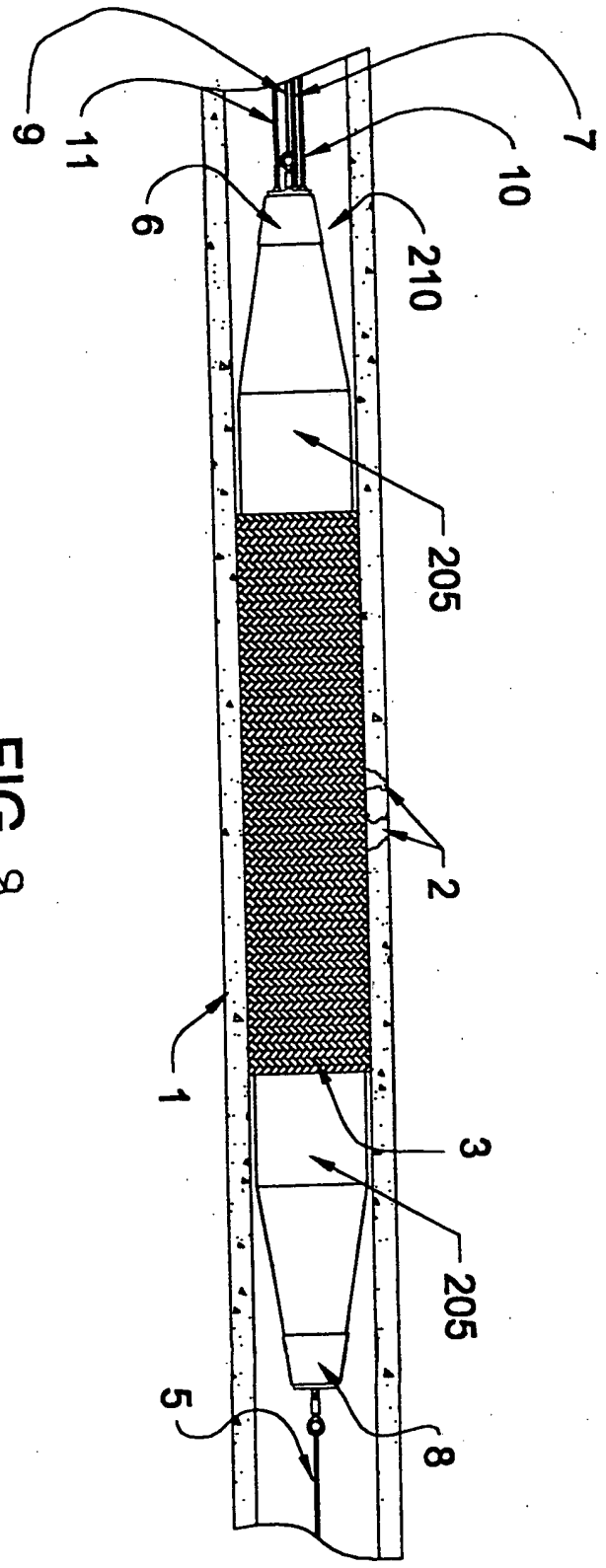


FIG. 8

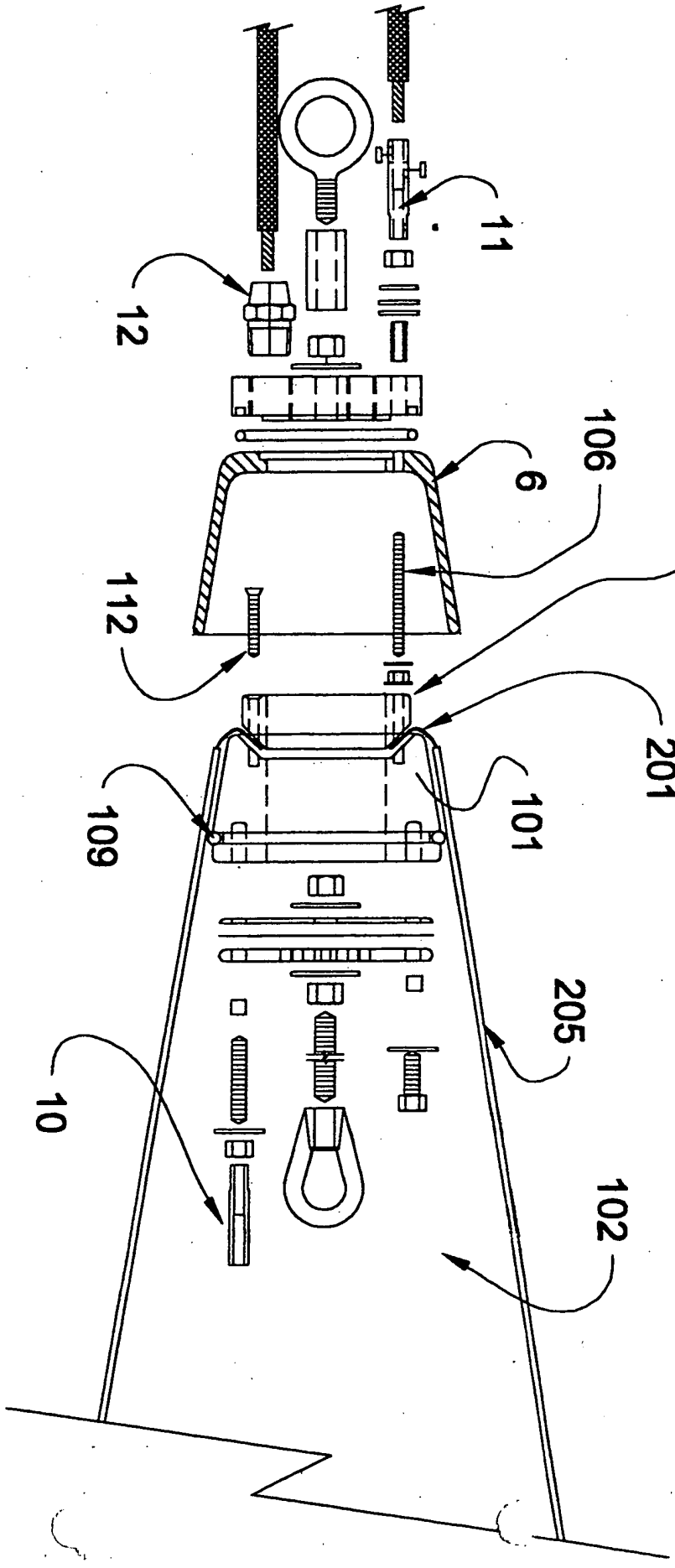


FIG 9

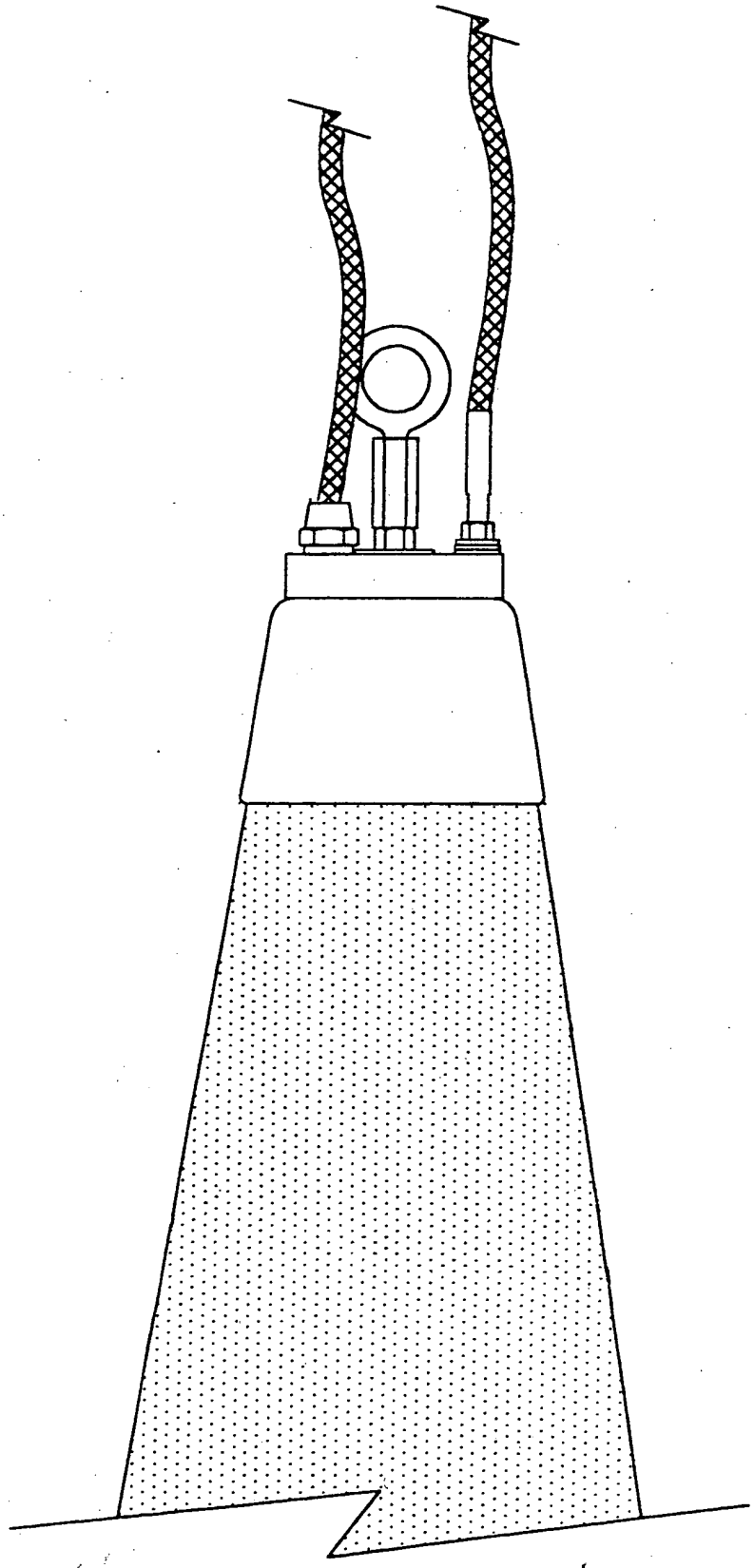


FIG 10

EXHIBIT B

Examiner's Advisory Action dated May 23, 2005

Advisory Action Before the Filing of an Appeal Brief

Application No.	Applicant(s)	
09/588,407	BLACKMORE ET AL.	
Examiner	**Art Unit**	
Steven D. Maki	1733	

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 03 May 2005 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

1. ☒ The reply was filed after a final rejection, but prior to or on the same day as filing a Notice of Appeal. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114. The reply must be filed within one of the following time periods:
   a) ☒ The period for reply expires 3 months from the mailing date of the final rejection.
   b) ☐ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.

   Examiner Note: If box 1 is checked, check either box (a) or (b). ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☐ The proposed amendment(s) filed after a final rejection, but prior to the date of filing a brief, will not be entered because
   (a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below);
   (b) ☐ They raise the issue of new matter (see NOTE below);
   (c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
   (d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.

   NOTE: _____. (See 37 CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☒ Applicant's reply has overcome the following rejection(s): see advisory action attachment.
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☒ For purposes of appeal, the proposed amendment(s): a) ☐ will not be entered, or b) ☒ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.

   The status of the claim(s) is (or will be) as follows:
   Claim(s) allowed: *18 and 19*.
   Claim(s) objected to: _____.
   Claim(s) rejected: *1,2,4-6,12-16,20,22 and 26-28*.
   Claim(s) withdrawn from consideration: *7-11 and 23-25*.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ The affidavit or other evidence filed after a final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
9. ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
10. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

11. ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: see advisory action attachment.
12. ☐ Note the attached Information Disclosure Statement(s). (PTO/SB/08 or PTO-1449) Paper No(s). _____
13. ☐ Other: _____.

ADVISORY ACTION ATTACHMENT

In view of the after final amendment filed 5-3-05:

Claims 18 and 19 are allowed.

In view of the after final amendment filed 5-3-05, the following objections / rejections have been withdrawn:

(a) the objection to the specification in paragraph 5 of the final office action,

(b) the objection to the disclosure in paragraph 6 of the final office action,

(c) the 35 USC 112 second paragraph rejection of claims 33, 35, 36, 45 and 50, and

(d) the 35 USC 112 first paragraph rejection of claims 29-47 and 50-52.

In view of the after final amendment filed 5-3-05, the following 112 rejections remain:

(1) **Claims 26-28 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.** See paragraph 2 of the final office action.

(2) **Claims 26-28 rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.** See paragraph 4 of the final office action.

In view of the after final amendment filed 5-3-05, the prior art rejections are as follows:

(A) **Claims 1 are 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Davies (US 5259901) in view of Hollingsworth (US 5266137).** As to claim 1, the subject matter of the non-metallic electrically conductive fibers comprising "carbon fibers, graphite fibers, carbon filaments or

graphite filaments" was addressed in paragraph 8 of the final office action; Hollingsworth suggesting the use of carbon fibers as electrical resistive heating elements.

(B) **Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Davis et al in view of Hollingsworth as applied above and further in view of Europe '761 (EP 432761), Guenthner et al (US 5,216,085) or Rianda (US 4,792,374).** Europe 761, Guenthner et al and Rianda are applied as in paragraph 9 of final office action.

(C) **Claims 1-2, 6, 12-13 and 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Japan '334 (JP 2-150334) in view of Japan '161 (JP 6-234161) or Japan '323 (JP 2-158323) and in view of Hollingsworth (US 5266137) and optionally further in view of at least one of Wood et al (US 5706861) and Guenthner et al (US 5216085).** As to claim 1, the subject matter of the non-metallic electrically conductive fibers comprising "carbon fibers, graphite fibers, carbon filaments or graphite filaments" requires the use of Hollingsworth and was addressed in paragraph 11 of the final office action; Japan 334 teaching the use of non-metallic electrically conductive fibers for resistive heating of an inflatable heating device and Hollingsworth suggesting the use of carbon fibers as resistive heating elements.

(D) **Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Japan '334 in view of Japan '161 or Japan '323 and in view of Hollingsworth and optionally further in view of at least one of Wood et al and Guenthner et al as applied above and further in view of Renaud (US 4861634).** Renaud is applied as in paragraph 12 of the final office action.

(E) **Claims 4-5 and 14-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Japan '334 in view of Japan '161 or Japan '323 and in view of Hollingsworth and optionally further at least one of Wood et al and Guenthner et al as applied above and further in view of Baker et al (US 4191383) and optionally Rankin (US 1362351) and Renaud (US 4861634).** Baker et al, Rankin and Renaud are applied as in paragraph 13 of the last office action.

(F) **Claims 20 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Japan '334 in view of Japan '161 or Japan '323 and in view of Hollingsworth and optionally further in view of at least one of Wood et al and Guenthner et al as applied above and further in view of Lippiatt (US 5,199,463).** Lippiatt is applied as in paragraph 14 of the final office action.

Remarks

Applicant provides no new arguments as to the 112 rejections against claim 26.

Applicant provides no new arguments as to the 103 rejections.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven D. Maki whose telephone number is (571) 272-1221. The examiner can normally be reached on Mon. - Fri. 7:30 AM - 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Blaine Copenheaver can be reached on (571) 272-1156. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Steven D. Maki
May 18, 2005

Steven D. Maki 5-18-05
STEVEN D. MAKI
PRIMARY EXAMINER
~~GROUP 1300~~
AU 1733

EXHIBIT C

Examiner's Final Office Action February 18, 2005

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/588,407	06/06/2000	Richard D. Blackmore	240-P-028	9445

26328 7590 02/18/2005

LAW OFFICE OF DAVID MCEWING
P.O. BOX 231324
HOUSTON, TX 77023

EXAMINER	
MAKI, STEVEN D	

ART UNIT	PAPER NUMBER
1733	

DATE MAILED: 02/18/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.	Applicant(s)	
09/588,407	BLACKMORE ET AL.	
Examiner	**Art Unit**	
Steven D. Maki	1733	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 December 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16 and 18-51* is/are pending in the application.

4a) Of the above claim(s) *7-11,23-25* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6,12-16,20-22 and 26-51* is/are rejected.

7)☒ Claim(s) *18 and 19* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

1) The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2) Claims 26-28, 33, 35, 36-45 and 50 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

As to claims 26 and 50, it is unclear in what the ports are located. Furthermore, the description of at least one port for inflation and deflation of the seamless closed body is confusing. If the closed body has an air port extending through the cylindrical shape, then body is no longer closed.

In claims 33 and 35, there is no antecedent basis for "said carbon fibers". Should claims 33 and 35 depend on claim 32 instead of claim 29?

In claims 36 and 44, the size of the Markush group is unclear since it does not include "and" (it is not in the format of selected from the group consisting of A, B and C).

In claim 36, the double recitation of "heat curable resin" is confusing and makes it unclear if more than one heat curable resin is being described. In claim 36 line 2, it is suggested to delete --supporting a heat curable resin--.

In claims 40 and 41, there is no antecedent basis for "the braided fibers". Should claims 40 and 41 depend on claim 39 instead of claim 38.

In claim 44, there is no antecedent basis for "the non-ferrous heating element". In claim 44, should --non-ferrous-- on line 5 be deleted?

3) The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the

art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4) Claims 26-47 and 50-52 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

As to claims 26-47 and 50-52, the subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention (i.e. the new matter) is the subject matter of:

(1) the body being a seamless closed body (claims 26 and 50);

(2) the fibers being non crimped (claims 29, 46);

(3) carbon fibers in the form of a non-crimped tape (claim 35).

(4) the twenty six member Markush Group (lines 5-19 of claims 36 and 44);

As to closed, the disclosed composite is not a seamless closed body since it has open ends as shown in figure 4.

As to the fibers being non crimped (a negative limitation), there is no explicit disclosure of the fibers being non-crimped in the disclosure. It is acknowledged that the original disclosure teaches carbon fibers and graphite fibers. See specification at page 5 line 15.and page 7 line 25. It is also acknowledged that the original disclosure uses the term "filament" as an alternative to the term "fibers". See page 17 line 25. However, the original disclosure does not address the issue of crimping and as such it is not seen

how the original disclosure shows that applicant had possession of "non crimped" subject matter. Furthermore, the disclosure of winding the fibers, braiding the fibers, arranging the fibers in tows, providing the fibers in the form of a non-woven tape is consistent with the starting / supply fibers being crimped or non-crimped and consequently cannot provide direction to select "non crimped" fibers / filaments.

As to the tape being non-crimped, the original disclosure's broad description of forming the fibers in a non-woven tape does not reasonably convey the more limited subject matter of a non-crimped tape.

As to the twenty six member Markush group, the original disclosure fails to reasonably convey *all* the members of the Markush group, which has no explicit basis in the original disclosure. For example, the original disclosure describes winding and braiding instead of weaving and stitch bonding. A woven fabric does not require braiding and the original disclosure fails to teach weaving instead of braiding. As to stitch bonding, the removably attaching by sewing the prepreg is not a step of forming a composite having stitch bonded fibers. Attaching a prepreg to a bladder using sewing and forming stitch bonded fibers are different concepts. The first relates to connecting the prepreg to the bladder whereas the second relates to connecting the fibers to each other. Another example, the original disclosure does not reasonably convey using "non-crimped" fibers and filaments for the reasons given above. Another example, the original disclosure does not supporting mixing and matching crimped fibers / filaments with fibers / filaments which are not required to be crimped so as to support for example "crimped fibers containing carbon filaments".

With respect to the various definitions described by applicant in the response dated 12-2-04, the original disclosure fails to describe or incorporate by reference those definitions (e.g. the definitions for weave and stitch bonding).

In conclusion, the above noted claims, especially claims 36 and 44, are redefining the invention in a manner not contemplated by applicant at the time of filing of this application.

5) The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required:

Incorporation of the description found in claim 18 into the specification. Support is found in original claim 18 at lines 1-3 of page 18 of the original disclosure.

Incorporation of the description of the non-ferrous heating element being carbon filaments or graphite filaments. Support in the original disclosure is found at page 5 line 15, page 7 line 25, page 17 line 26, abstract page 25; the original disclosure reasonably conveying using carbon fibers, graphite fibers, carbon filaments or graphite filaments.

6) The disclosure is objected to because of the following informalities:

The continuing data at page 1 lines 12-15 should be inserted before the first sentence on page 1.

The abstract is too long and should be one paragraph. It is suggested to delete the last seven lines of the abstract.

Appropriate correction is required.

7) The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Davies

8) **Claims 1, 3-6, 21 and 29, 32-35 and 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Davies (US 5259901) in view of Hollingsworth (US 5266137).**

Davis et al discloses an inflatable mandrel (inflatable bladder) comprising a cured matrix material such as silicone elastomer or a urethane elastomer and reinforcement fiber wherein the fiber is incorporated in the elastomer using hoop winding, helical winding and/or polar winding. The reinforcing fiber may be a graphite fiber (graphite fibers being non-metallic fibers and having the property of being electrically conductive). See col. 7 lines 47-50. Claims 1 and 21 contain a product by process limitation. In claim 1, for example, the product by process limitation is "said flexible matrix being cured to a stable elastomeric state by electric resistive heating of said fibers". This product by process language fails to require structure not shown by Davis et al. See MPEP 2113. In any event: It would have been obvious to provide the inflatable mandrel of Davis et al so as to satisfy ""said flexible matrix being cured to a stable elastomeric state by electric resistive heating of said fibers" (emphasis added) since Davis et al, which teaches using fibers such as graphite fibers, teaches curing the

matrix material (e.g. the silicone elastomer) using an autoclave. Davis does not recite using electrical cable lines to connect the fibers to an energy source.

As to claims 1, 3 and 21, it would have been obvious to one of ordinary skill in the art to use cable lines to connect the fibers (carbon fibers) of the inflatable mandrel of Davies et al to an electrical energy source so that the inflatable bladder can be heated by resistive heating and thereby cure the composite material during the use of the inflatable bladder in composite manufacture since (a) Davies et al teaches using the inflatable mandrel including wound fibers in composite manufacture in which the composite is cured and (b) Hollingsworth, also directed to using a mandrel in composite manufacture, suggests supplying heat for curing composite material on a mandrel using resistive heating wherein carbon fibers may be used as the resistance heating elements (columns 9,10). Hence, Davies et al and Hollingsworth teach *curing composite material on a mandrel*. Hollingsworth adds to the disclosure of Davies et al by teaching to *use electrical resistance elements such as carbon fibers to supply heat for curing the composite material*. One of ordinary skill in the art would have been motivated to use electrically conductive fibers (carbon fibers) as the fibers in Davies et al's mandrel to obtain the benefit of providing a heating means, which allows Davies et al inflatable mandrel / bladder to be used in composite manufacture process in which heating is used during curing.

As to "generally hollow inflation chamber", Davies et al's inflatable mandrel defines a "generally hollow inflation chamber" since it is inflatable / collapsible.

As to claims 4-6 and 21, note Davis et al's teachings regarding the reinforcing fiber. In any event: The limitation of the fibers being at ± 45 degrees (claim 4) / the 50-90% coverage (claim 5) would have been obvious in view of Davis et al's teaching that the fiber is incorporated in the elastomer using hoop winding, helical winding and/or polar winding. The limitation of the fibers being in the form of tows or bundles (claim 5) or the fibers being in the form of non-woven tape (claim 6) would have been obvious since (a) Davis et al teaches the use of reinforcing fibers and (b) it is taken as well known / conventional per se in the composite art to wind fibers which are in the form of tows, bundles, or non-woven tape.

As to new claims 29, 32-35 and 46, it would have been obvious to use "non-crimped" fibers as claimed in the inflatable mandrel of Davies et al in view of Davies et al's teaching to *filament wind fibers* which do not stretch too much (col. 7 lines 46-55). As to the fibers being carbon fibers, note the suggestion from Hollingsworth that electrical resistive heating elements include carbon fibers.

9) **Claims 2 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Davis et al in view of Hollingsworth as applied above and further in view of Europe '761 (EP 432761), Guenthner et al (US 5,216,085) or Rianda (US 4,792,374).**

As to claims 2 and 31, it would have been obvious to use fluorosilicone or fluorocarbon for the matrix of the bladder (inflatable mandrel) of Davis et al in view of Europe '761, Guenthner et al or Rianda – Europe '761 suggesting use of fluorosilicone for a bladder, Guenthner et al suggesting the use of fluorocarbon for a bladder and Rianda suggesting the use of fluorosilicone for a bladder.

10) **Claims 30 and 47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Davis et al in view of Hollingsworth as applied above and further in view of Renaud (US 4861634).**

As to claims 30 and 47, it would have been obvious to one of ordinary skill in the art to monitor and control the heating as claimed since Renaud, also disclosing electrical resistive heating, teaches maintaining temperature at a desired temperature (during hardening of resin) by determining the temperature and controlling the temperature using a means for controlling temperature connected to the ends of the resistive heating elements (wires). See col. 5 lines 65-68.

Japan '334

11) **Claims 1-3, 6, 12-13, 26-27, 36, 38, 50 and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Japan '334 (JP 2-150334) in view of Japan '161 (JP 6-234161) or Japan '323 (JP 2-158323) and further in view of at least one of Wood et al (US 5706861), Hollingsworth (US 5266137) and Guenthner et al (US 5216085).**

Japan '334, directed to insitu pipe repair, discloses an apparatus for repairing a pipe using a repairing sleeve having curable adhesive comprising:

- an **inflatable heating device** comprising a cylindrical cloth and an expandable air tight layer;
- a pressurized fluid conduit 11 and a hole 10 for inflating the cloth and air tight expandable layer;

As to generally hollow inflation chamber, Japan '334's generally cylindrical inflatable heating device defines a "generally hollow" inflation chamber (best seen in figure 4). In any event: it would have been obvious to one of ordinary skill in the art to mount Japan '334's inflatable heating device (4, 6, 7) on a first end piece and a second end piece so as to define a "generally hollow" inflation chamber since Japan '334 teaches mounting a first end and a second end of an inflatable heating device having an air tight layer so as to form an air tight space 4' and shows that an inflatable device mounted to a first end piece and second end piece may define a relatively large space so as to be "generally hollow" (see figure 6).

As to the matrix, one of ordinary skill in the art would readily understand that the rubber described by Japan '334 for the flexible expandable body 4 is a cured elastomer. In any event: it would have been obvious to one of ordinary skill in the art to use an cured elastomeric / thermoset resin matrix such as silicone for Japan '334's bladder since cured elastomeric / thermoset resin matrix such as silicone matrix is a well known / conventional material per se for an inflatable bladder as evidenced by at least one of Wood et al (silicone at col. 4), Hollingsworth (silicone at col. 9), and Guenthner et al (fluorocarbon at abstract, col. 2). In other words, the use of cured elastomeric / thermoset resin for the bladder is suggested by and is nothing more than the use of the usual material used for bladders as evidenced by at least one of Wood et al, Hollingsworth and Guenthner et al. Wood et al specifically teaches the use of silicone for a bladder used in the art of lining / repairing pipes. Hollingsworth contains the

additional teaching of the use of carbon fibers for resistive heating. Guenthner et al suggests the specific material set forth in claims 2 and 13.

As to product by process language (claim 1), the product by process limitation of "said flexible matrix being cured to a stable elastomeric state by electric resistive heating of said fibers" fails to require structure (composition / state of cure) not suggested by the at least one of Wood et al, Hollingsworth and Guenthner et al. In other words, each of these secondary references suggest cured material for a bladder.

As to the electrical cable lines (claim 1), this subject matter is suggested by Japan '334 which suggests supplying current to the opposite ends of the conductive cloth using wires.

As to claim 2, it would have been obvious to use fluorocarbon for the matrix of the bladder in view of Guenthner et al's suggestion to use fluorocarbon for a bladder.

As to claim 3, it would have been obvious to use carbon fibers in Japan '334's inflatable heating device since Hollingsworth, directed to a mandrel having an inflatable support (bladder), teaches that **carbon fibers** may used as resistance heating elements (column 10).

As to claim 6, it would have been obvious to provide the fibers in the form of a non-woven tape since (a) Japan '334 suggests using fibers and (b) fibers in the form of non-woven tape for use for example in a woven cloth are taken as well known / conventional per se.

As to claim 12, the limitation of the claimed air port and a vacuum port would have been obvious in view of (a) Japan '334 teaching to use a pressurized fluid conduit

to supply pressurized fluid and to discharge pressurized fluid and (b) it is taken as well known / conventional in the lining art to provide an air port for communication with a compressed air source for inflating a bladder and a separate vacuum port for communicating with a vacuum source for deflating the bladder.

As to claim 13, it would have been obvious to use fluorocarbon for the matrix of the bladder in view of Guenthner et al's suggestion to use fluorocarbon for a bladder.

As to new claims 26-27, 36, 38, 50 and 52, the applied prior art is applied as above. As to the additional features: Japan '334 suggests locating the fibers substantially throughout since the cloth extends from one end to the other end. As to seamless and closed, note that Japan '334's inflatable heating device forms an air tight space 4'. As to carbon fibers, note the suggestion from Hollingsworth that electrical resistive heating elements include carbon fibers. As to crimping, Japan '334 suggests using crimped fibers. As to sized to contact, see size of inflatable heating device in figure 3.

12) **Claims 28, 37 and 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Japan '334 in view of Japan '161 or Japan '323 and further in view of at least one of Wood et al, Hollingsworth and Guenthner et al as applied above and further in view of Renaud (US 4861634).**

As to claims 28, 37 and 51, it would have been obvious to one of ordinary skill in the art to monitor and control the heating as claimed since Renaud, also disclosing electrical resistive heating, teaches maintaining temperature at a desired temperature (during hardening of resin) by determining the temperature and controlling the

temperature using a means for controlling temperature connected to the ends of the resistive heating elements (wires). See for example col. 5 lines 65-68.

13) **Claims 4-5, 14-16, 21 and 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Japan '334 in view of Japan '161 or Japan '323 and further in view of at least one of Wood et al, Hollingsworth and Guenthner et al as applied above and further Baker et al (US 4191383) and optionally Rankin (US 1362351) and Renaud (US 4861634).**

As to claims 4-5, 14-16, 21 and 39-41, it would have been obvious to provide the electrically conductive fibers in the bladder as braided fibers since in view of Baker et al's suggestion to use braided material in a bladder which like that of Japan '334 is inflatable. *Claims 4-5 and 21 read on the fibers being braided since they recite fibers being helically arranged instead of being filament wound fibers.*

It is noted that claims 14-16 and 18-19 fail to require the temperature tolerant fiber windings and the electrically conductive fiber windings to comprise different materials. In any event: it would have been obvious to one of ordinary skill in the art to use temperature tolerant fibers and electrically conductive fibers in view of (a) Renaud's teaching to one of ordinary skill in the pipelining / pipe repairing art to use a combination of reinforcing fibers such as glass fibers and conductive wires for resistively heating in a lining material and (b) Rankin's teaching to use non-conducting filaments with a conductor in a heating element which is to be resistively heated.

14) **Claims 20, 22, 44 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Japan '334 in view of Japan '161 or Japan '323 and further in**

view of at least one of Wood et al, Hollingsworth and Guenthner et al as applied above and further in view of Lippiatt (US 5,199,463).

As to claims 20, 22, 44 and 48, it would have been obvious to removably attach a pre preg comprising fibers and thermosetting resin since Lippiatt, also directed to repairing pipelines, suggests removably attaching lining material in the form of a pre-preg (fibrous material impregnated with heat curable resin) to a bladder using loose ties.

15) **Claims 45 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Japan '334 in view of Japan '161 or Japan '323 and further in view of at least one of Wood et al, Hollingsworth and Guenthner et al and further in view of Lippiatt as applied above and further in view of Renaud (US 4861634).**

As to claims 45 and 49, it would have been obvious to one of ordinary skill in the art to monitor and control the heating as claimed since Renaud, also disclosing electrical resistive heating, teaches maintaining temperature at a desired temperature (during hardening of resin) by determining the temperature and controlling the temperature using a means for controlling temperature connected to the ends of the resistive heating elements (wires). See for example col. 5 lines 65-68.

Allowable Subject Matter

16) **Claims 18 and 19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.**

Claims 42 and 43 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112 set forth in this Office action.

Claim 20 would be allowable if amended to include all of the limitations of claims 12 and 18.

Claim 18 (dependent on claim 12) and claim 42 (dependent on claim 36) recite the additional limitation of "the heating element includes a plurality of filament wound fibers".

When considered as a whole, the combination of Davies et al and Hollingsworth fail to suggest "An apparatus for curing a prepreg repair material supporting a heat curable resin for in-situ repair of a conduit" as set forth in the combination of claims 12 and 18 or "An apparatus for curing a heat curable resin of a pre-preg repair material [supporting a heat curable resin] for in-situ repair of a conduit" as set forth in the combination of claims 36 and 42.

When considered as a whole, there is no suggestion to combine Davies et al and Japan '334 since (1) Davies et al is directed to manufacturing composite articles by methods such as filament winding, braiding, tape rolling, hand lay-up and resin transfer molding whereas Japan '334 is directed to a device for repairing pipeline partially from inside, (2) Davis et al teaches filament wound fibers but not electrical resistive heating, and (3) Japan '334 teaches electrically resistive heating of a woven or knitted fabric comprising crimped threads, but not filament wound fibers.

Furthermore, Japan '334's teaching of a woven or knitted fabric comprising crimped threads and Baker et al's teaching of braided reinforcement fails to suggest modifying Japan '334 such that the resulting inflatable heating device comprises "the

heating element includes a plurality of filament wound fibers" (emphasis added) instead of woven fibers, knitted fibers or braided fibers.

Remarks

17) Applicant's arguments filed 12-2-04, 8-6-04 and 4-9-04 have been fully considered but they are not persuasive.

Applicant's election of Group I in the reply filed on 4-9-04 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)). Applicant comments that claims 21 and 22 should be part of the elected group rather than claim 20. Examiner comments that claims 20-22 are part of the elected group and adds the following comments for clarification: Claims 7-11 and 23-25 remain withdrawn from considered as being directed to a non-elected invention. Unlike claims 1-6, 12-16, 18-22 and 26-51, each of these withdrawn claims require the subject matter of a *method step of using electrical resistive heating to cure the material of the inflatable device / cylindrical body* (in contrast using electrical resistive heating to cure *a prepreg* on the inflatable device / cylindrical body).

With respect to Davies et al, Applicant argues that Davis does not suggest using any fibers having electrical properties. Applicant is incorrect since Davies et al teaches using graphite fibers, which are electrically conductive fibers.

Applicant's argument that Davies et al teaches away from the invention by teaching use of fibers for mechanical strength in contrast to electrical conductivity is not

persuasive since Davies et al teaches that graphite fibers (electrically conductive fibers) may be used in the inflatable mandrel.

Applicant's argument that Davies et al teaches away from the invention by teaching the use of Kevlar fibers with silicone elastomers is not persuasive since Davies et al teaches that graphite fibers (electrically conductive fibers) may be used in the inflatable mandrel.

Applicant's argument that Davies et al teaches away from the invention by teaching the use of bagging and autoclaving technology as the method of curing the elastomer of the bladder is not commensurate in scope with the claims and is therefore not persuasive. All of the elected claims read on a bladder having a matrix cured by bagging and autoclaving technology. None of the elected claims require a *method step of using electrical resistive heating to cure the material of the inflatable device / cylindrical body.*

Applicant argues that Hollingsworth's mandrel is used in a dramatically different application. The examiner disagrees. Hollingsworth's mandrel, like Davies et al's mandrel, is used for composite manufacture. — BUT NOT FOR TUBE REPAIR

Applicant's remaining arguments regarding Hollingsworth are not persuasive since (1) Davies et al and Hollingsworth teach curing composite material on a mandrel, (2) the mandrel of Davies et al may comprise electrically conductive fibers (graphite fibers) and (3) Hollingsworth suggests supplying heat for curing of composite material by resistively heating electrically conductive fibers. Where are the fibers in Davies mandrel? Answer: the fibers are embedded in the cured elastomeric material.

With respect to Japan '334, applicant's argument that a polyethylene terephthalate thread coated with carbon powder will not posses the mechanical properties of carbon or graphite fibers combined with flexibility and compatibility to silicone elastomers. The argument is not persuasive since "non-metallic electrically conductive fibers" (claim 1), "non-ferrous heating element" (claim 12) and "heating element" (claim 20) each read on polyethylene terephthalate thread coated with carbon powder wherein Japan '334 teaches passing electric current through this material to resistively heat.

Applicant argues that applicant's invention specifically claims use of non-metallic electrically conductive fibers with an expandable matrix. First: claims 12, 20 and 22 fail to require "non-metallic electrically conductive fibers". Claims 12 and 22 merely recite "non-ferrous heating element" (e.g copper). Claim 20 merely recite "heating element" (e.g. copper or ferrous material). Second and more importantly, **Japan '334 discloses non-metallic electrically conductive fibers for an inflatable heating device for pipe repair.** The fibers are non-metallic since they comprise polymer (polyethylene terephthalate) and carbon (but not metal). The fibers are electrically conductive due to the carbon. **The claimed "non-metallic electrically conductive fibers" read on Japan '334's conductive fibers.** The examiner concurs that Japan '334 does not teach *embedding* (the non-metallic conductive fibers for resistive heating are *on* the matrix material instead of *within* the matrix material. However, Japan '161 or Japan '334 suggest heating elements for resistive heating may be *embedded / within* matrix material instead of on matrix material; it being emphasized that the conductive fibers for

resistive heating in Japan '334 and the heating elements for resistive heating in Japan '161, Japan '323 are used for the *same* purpose - supplying heat to lining material within a pipe to cure the resin of the lining material.

Applicant asserts that the prior art does not provide any expectation of success of the reliable and robust properties taught by applicant's invention. This argument is not commensurate in scope with the claims. None of the claims require the inflatable heating device to have "reliable and robust properties".

18) Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

19) Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven D. Maki whose telephone number is (571) 272-1221. The examiner can normally be reached on Mon. - Fri. 7:30 AM - 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Blaine Copenheaver can be reached on (571) 272-1156. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Steven D. Maki
February 18, 2005

Steven D. Maki 2-18-05
STEVEN D. MAKI
PRIMARY EXAMINER
~~GROUP 1300~~
AU 1733

Claim 20 would be allowable if amended to include all of the limitations of claims 12 and 18.

Claim 18 (dependent on claim 12) and claim 42 (dependent on claim 36) recite the additional limitation of "the heating element includes a plurality of filament wound fibers".

When considered as a whole, the combination of Davies et al and Hollingsworth fail to suggest "An apparatus for curing a prepreg repair material supporting a heat curable resin for in-situ repair of a conduit" as set forth in the combination of claims 12 and 18 or "An apparatus for curing a heat curable resin of a pre-preg repair material [supporting a heat curable resin] for in-situ repair of a conduit" as set forth in the combination of claims 36 and 42.

When considered as a whole, there is no suggestion to combine Davies et al and Japan '334 since (1) Davies et al is directed to manufacturing composite articles by methods such as filament winding, braiding, tape rolling, hand lay-up and resin transfer molding whereas Japan '334 is directed to a device for repairing pipeline partially from inside, (2) Davis et al teaches filament wound fibers but not electrical resistive heating, and (3) Japan '334 teaches electrically resistive heating of a woven or knitted fabric comprising crimped threads, but not filament wound fibers.

Furthermore, Japan '334's teaching of a woven or knitted fabric comprising crimped threads and Baker et al's teaching of braided reinforcement fails to suggest modifying Japan '334 such that the resulting inflatable heating device comprises "the

persuasive since Davies et al teaches that graphite fibers (electrically conductive fibers) may be used in the inflatable mandrel.

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Applicant's argument that Davies et al teaches away from the invention by teaching the use of bagging and autoclaving technology as the method of curing the elastomer of the bladder is not commensurate in scope with the claims and is therefore not persuasive. All of the elected claims read on a bladder having a matrix cured by bagging and autoclaving technology. None of the elected claims require a *method step of using electrical resistive heating to cure the material of the inflatable device / cylindrical body*.

Applicant argues that Hollingsworth's mandrel is used in a dramatically different application. The examiner disagrees. Hollingsworth's mandrel, like Davies et al's mandrel, is used for composite manufacture.

Applicant's remaining arguments regarding Hollingsworth are not persuasive since (1) Davies et al and Hollingsworth teach curing composite material on a mandrel, (2) the mandrel of Davies et al may comprise electrically conductive fibers (graphite fibers) and (3) Hollingsworth suggests supplying heat for curing of composite material by resistively heating electrically conductive fibers. Where are the fibers in Davies mandrel? Answer: the fibers are embedded in the cured elastomeric material.

EXHIBIT D

Hollingsworth US 5,266,137

"Rigid Segmented Mandrel with Inflatable Support"

EXHIBIT E

Japan '334

"Device For Partially Repairing Pipeline Form Inside"

PTO 04-0398

CY=JA DATE=19900608 KIND=A
PN=02-150334

DEVICE FOR PARTIALLY REPAIRING PIPELINE FROM INSIDE
[Kanro wo sono naimen kara bubunhoshuu suru souchi]

Kunihiro Mori, et al.

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. November 2003

Translated by: FLS, Inc.

PUBLICATION COUNTRY (19): JP

DOCUMENT NUMBER (11): 020150334

DOCUMENT KIND (12): A [PUBLISHED UNEXAMINED APPLICATION]

PUBLICATION DATE (43): 19900608

APPLICATION NUMBER (21): 630304625

APPLICATION DATE (22): 19881130

INTERNATIONAL CLASSIFICATION (51): B 29 C 63/34
F 16 L 55/16
//B 29 K 105:08
B 29 L 23:22

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APPLICANTS (71): TOKYO GAS CO., LTD.; ASHIMORI INDUSTRY CO., LTD.

TITLE (54): DEVICE FOR PARTIALLY REPAIRING PIPELINE FROM INSIDE

FOREIGN TITLE (54A): KANRO WO SONO NAIMEN KARA BUBUNHOSHUU SURU SOUCHI

SPECIFICATION /195*

1. Title of the Invention

Device for Partially Repairing Pipeline from Inside

2. Claims

1. A device that partially repairs a pipeline from the inside and in which an expandable body that generates heat when energized and that is made of a material that has air-tight properties is mounted over the surface of the hollow main unit of a repairing tool that can be inserted into a pipeline, in which both ends of this expandable body are connected to said main unit of the repairing tool to create an air-tight space between the main unit of the repairing tool and the expandable body, and in which an operating liquid passage that is for pressure-feeding a liquid into and discharging the liquid from the air-tight space is structured on the main unit side of the repairing tool.

2. A device of Claim 1 that partially repairs a pipeline from the inside characterized by the expandable body being a cloth body woven by using crimped threads, by an air-tight layer made of rubber or an elastic resin being created on the inner surface of the cloth body, and by applying a paint that generates heat when energized onto said cloth body or by impregnating said cloth body with the paint.

3. A device of Claim 1 that partially repairs a pipeline from the inside characterized by the expandable body being a knitted cloth body, by an air-tight layer made of rubber or an elastic resin being created on the inner surface of the cloth body, and by applying a paint that generates heat when energized onto said cloth body or by impregnating

* Numbers in the margin indicate pagination in the foreign text.

said cloth body with the paint.

4. A device of Claim 1 that partially repairs a pipeline from the inside characterized by having a structure in which a cloth body, which is the expandable body, provided with an air-tight layer made of rubber or an elastic resin on its inner side is woven or knitted by using threads that generate heat when energized.

3. Detailed Explanation of the Invention

[Field of Industrial Application]

The present invention pertains to devices that partially repair pipelines that are buried underground, such as gas piping, water pipes, etc., from the inside.

[Prior Art]

As a repairing method utilized when a leakage source, such as partial corrosion, occurs in a gas pipeline, etc., a method (Kokai No.58-17278) in which it is repaired by placing a repairing material against the inner surface of the pipeline is commonly known.

This commonly known example is a repairing method in which an adhesive is sprayed onto the location on the inside surface of a pipeline that needs to be repaired to form an adhesive layer and in which a softened ring-shaped thermosetting repairing material is adhered after expanding the diameter. /196

In the above repairing method, the device shown in Figure 6 is utilized.

In Fig. 6, [101] is a ring-like rubber plate, and its ends are fixated to side plates, [102] and [102']. One [102] of the side plates is provided

with an outlet for a hot-air pipe [103] so that hot air will be sprayed onto the outer periphery of the rubber plate [101] and is also connected to the front end of a compressed-air pipe [104] so that compressed air can be injected into the rubber plate [101].

Thus, the above-described repairing material [105] is attached onto the outer periphery of the rubber plate [101], the repairing material [105] becomes softened by the hot air jetted out of the hot-air pipe [103], and the repairing material [105] becomes expanded in the diametrical direction by the compressed air injected form the compressed air pipe [104].

[Problems that is to be Solved]

However, since hot air is utilized to soften the repairing material, this commonly known example has the following problems.

The heat source of the hot air is generated above ground and is then guided to the repairing location through the pipe. Therefore, the heat source and the repairing location are separated, and the temperature drops before the hot air reaches the repairing location. Therefore, the softening of the repairing material takes time.

Moreover, when the repairing material is expanded in the diametrical direction and is adhered to the pipe's inner surface in the commonly known example, the hot air does not reach the adhesive layer after that, and the hardening of the adhesive cannot be hastened by heating. Therefore, the repairing material needs to be pressured against the pipe's inner surface for a long time until the adhesive becomes hardened naturally.

Moreover, since hot air does not reach even the repairing material after the repairing material is adhered to the pipe's inner surface by

having its diameter expanded, solidification of the repairing material starts and the repairing material cannot be kept sufficiently pressured against the pipe's inner surface. For this reason, there is a risk of a gap being created between the pipeline's inner surface and the repairing material after the repair is finished. Moreover, there is a hot-air temperature gradient between the vicinity of the output of the hot-air pipe and its opposite side, and heating cannot be performed evenly in the circumferential direction.

The present invention is proposed in light of the above problems, and its purpose is to propose a device that partially repairs the pipeline from its inner surface and that is capable of expeditious and reliable repairing operations using repairing materials.

[Means for Solving the Problems]

In the present invention, a device having the following structure is proposed as a means for solving the above-mentioned problems.

An expandable body that generates heat when energized and that is made of a material that has air-tight properties is mounted over the surface of the hollow main unit of a repairing tool that can be inserted into a pipeline, both ends of this expandable body are connected to said main unit of the repairing tool to create an air-tight space between the main unit of the repairing tool and the expandable body, and an operating liquid passage, which is for pressure-feeding a liquid into and discharging the liquid from the air-tight space, is structured on the main unit side of the repairing tool. Thus, the device repairs the pipeline from its inside.

In the above device, the expandable body that generates heat when energized is a fabric body woven with crimped threads. It is permissible

to structure an air-tight layer that is made of rubber or an expandable resin on the inner surface of this fabric body and to then have a paint that generates heat when energized applied to or impregnated in said fabric body.

An example of the paint that generates heat when energized is one obtained by admixing 50~60 parts of graft-polymerized acetylene black to an urethane resin, which will be the medium resin, by kneading the mixture, and by then dissolving it in methylethylketone.

This heat-generating paint may be applied to the surface of the fabric body by using a brush or may be sprayed onto it by means of a gun. Note, however, that the homogenization of the application needs much caution since the heat becomes locally excessive or insufficient unless it is homogeneous over the entire surface.

Next, as for the means of impregnation, the fabric body may be directly immersed in the heat-generating paint or the fabric body may be woven by using threads that have been immersed.

The fabric body must have expandability, and for this, crimped threads may be utilized as mentioned earlier, or expandability may be provided to the fabric body by weaving threads.

Next, as the means for allowing the expandable body to generate heat, a method in which a heat-generating paint is applied to or impregnated in the fabric body as mentioned earlier and a method in which the fabric body is made by knitting or weaving threads which themselves generate heat are conceivable.

Examples of such heat-generating threads are ones that are obtained by inserting carbon-type heat-generating bodies into the cores of

expandable resin threads, organic fiber yarns containing conductive particles, etc. /197

[Operation of the Invention]

In the above device, a repairing sleeve is first attached onto the outside of the expandable body of the repairing tool's main unit, an adhesive is then applied to the outside surface of the repairing sleeve, and the repairing tool's main unit (repairing device) is inserted into the pipe to the repairing location by using an inserting body. Next, an operating liquid is pressured into the air-tight space, the expandable body and the repairing sleeve provided on the outside of it are expanded in the diametrical direction, and the repairing sleeve is adhered tightly to the repairing location.

Next, the expandable body is made to generate heat by energizing this expandable body by means of a power feeding device, and the adhesive is heated through the repairing sleeve until it becomes gelatinized. After this condition is achieved, the power feeding is stopped to solidify the adhesive. This solidification may be carried out by waiting for natural cooling to occur or forcibly by, for example, injecting a coolant into the air-tight space.

After the repairing sleeve becomes completely attached to the repairing location, the expandable body is made to shrink in the diametrical direction by discharging the operating liquid from the air-tight space, and the operation is then finished by pulling the repairing tool's main unit to the outside of the pipe.

[Working Example and Operation]

A working example of the device of the present invention will be explained below based on Figs. 1~5.

The reference numeral [1] is the repairing tool's main unit. This main unit [1] has a through-hole [2] that runs from an inlet [2'] to an outlet [2''] on the inside and has a structure in which a wheel [3] is attached to the front and the rear by means of a spring [3''] via a wheel arm [3'] that can operate in the radial direction.

[4] is an expandable body. Both ends, [5] and [5'], of this expandable body [4] are fixated on the outer periphery of the trunk part [1'] of said main unit [1] to form an air-tight space [4'] with the trunk part [1'] of the main unit [1].

The expandable body [4] is made up of an inner-surface air-tight layer [6] that consists of an elastic resin or rubber and a cylindrical cloth [7] made by using crimped threads.

On both ends of the cylindrical cloth [7], metallic tapes, [8] and [8'], are wrapped around and fixated to the outside periphery. These metallic tapes, [8] and [8'], have electricity fed to them from a power feeding device (not illustrated) via the power lines [9] of a cathode and an anode, respectively. Incidentally, for the cylindrical cloth [7], covered yarns obtained by wrapping crimped threads of polyethylene terephthalate around crimped threads of polyurethane are utilized for the weft and crimped threads of polyethylene terephthalate are utilized for the warp. This cylindrical cloth [7] is obtained by impregnating it with the following heat-generating paint and by then drying it.

The heat-generating paint was obtained by admixing 50~60 parts of graft-polymerized acetylene black to a urethane resin that would become

the medium resin, by kneading the mixture, and by then dissolving it in methylethylketone.

Metallic-powder-type and carbon-type are conceivable as the conductive additive of the heat-generating paint, but the carbon-type is preferred in terms of the workability, cost, and controllability and graft-polymerized acetylene black is the best of all. Since this graft-polymerized acetylene black has excellent dispersibility in a medium and can therefore be attached to the processed threads evenly, a homogeneous resistor can be attained, and passing current will not flow and heat locally. Therefore, it is very safe without a risk of combustion.

As for said cylindrical cloth [7], it may instead be obtained by impregnating crimped threads with said heat-generating paint in advance and by then drying it and shaping it into a cylinder. Or it may be obtained by crimping an organic fiber yarn that contains conductive particles and by then shaping it into a cylinder.

[10] is a pressure injecting hole for the operating liquid. This liquid pressure injecting hole [10] is provided in the air-tight space [4'] created between the trunk part [1'] of said main unit [1] and the expandable body [4], and this injection hole [10] is connected to a compressor (not illustrated) via a liquid pressure conduit [11].

[12] in the figure is an inserting body that is connected to one end of said main unit [1] by means of a coupling [13].

Next, a repairing example in which the device of the above working example is utilized will be explained.

As shown in Fig. 3, it will be assumed that a pinhole [15] has occurred in one part of the pipeline [14].

First, a thermosetting repairing sleeve [16] having a diameter smaller than that of the inner diameter of the pipeline [14] is attached to the outside of the expandable body [4] of the repairing device.

Next, an adhesive [18] is applied to the outer surface of the repairing sleeve [16] and a small internal pressure is applied to the air-tight space [4'] inside the expandable body [4] in order to keep this repairing sleeve [16] from coming off of the expandable body [4]. /198

Next, a work hole is drilled and is cut with the pipeline [14] exposed inside the hole. From the inlet that the cutting made, a repairing device is inserted by using an inserting body [12]. The repairing device moves inside the pipeline [14] smoothly by means of the wheels [3].

After confirming that the repairing device has been inserted to reach the location of the pinhole [15], the insertion of the device is stopped. This condition is shown in Fig. 3. The repairing location [15] has been detected in advance, and the repairing device is inserted based on this data.

After that, a liquid-pressure operating liquid is fed to the air-tight space [4'] inside the expandable body [4] through the liquid pressure conduit [11] and injection hole [10] to expand the expandable body [4]. In this case, the cylindrical cloth [7] can expand or shrink together with the air-tight layer [6] since it is made of crimped threads. For this reason, the expandable body [4] expands evenly in the longitudinal direction. Then the repairing sleeve [16] attached to the outside of the expandable body [4] is also evenly expanded in the longitudinal direction and eventually becomes closely attached to the pinhole [15] location on

the inner surface of the pipeline [14].

Next, voltage is applied to the electrodes of the metallic tapes, [8] and [8'], located on both ends of the cylindrical cloth [7] from a power feeding device through an electrical wire [9] to allow the cylindrical cloth [7] to generate heat. As the temperature of the cylindrical cloth [7] starts rising, the adhesive [18] of the repairing sleeve [16], which is located on the outside, becomes heated.

The adhesive [18] is heated by the heat generated by the cylindrical cloth [7] for a period of time longer than the gelation time of the adhesive [18].

After the gelation time of the adhesive [18] has been exceeded, the heat generation is stopped by stopping the power feeding to the cylindrical cloth [7], and the hardness of the adhesive [18] of the repairing sleeve [16] is increased by cooling it by natural cooling or by another forcible cooling means. This condition is shown in Fig. 4.

After cooling is completed, the liquid pressure is discharged from the air-tight space [4'], which is inside the expandable body [4], through the liquid pressure conduit [11] to shrink the expandable body [4] in the diametrical direction.

After closely adhering the repairing sleeve [16] to the pinhole [15] on the inner surface of the pipeline [14] and shrinking the expandable body [4] in the diametrical direction as mentioned earlier, the repairing device is collected from inside the pipeline [14] to finish the repairing operation.

The condition in which the pinhole [15] has been repaired by means

of the repairing sleeve [16] is illustrated in Fig. 5.

Moreover, in order to prevent the adhesive [18] applied to the repairing sleeve [16] from drooping down, it is preferred that the outer periphery of the repairing sleeve [16] be wrapped with the cloth [17] and that the cloth [17] be impregnated with the adhesive [18] in advance.

Moreover, the following may instead be utilized as the repairing sleeve: the article that the applicant utilized in the earlier application Tokugan No.63-107991 and that is obtained by attaching a sealing material on the outer periphery of a pipe-shaped low-melting-point crystalline shape memory resin, or a thermosetting glass fiber reinforced plastic that is a gel at room temperature.

In the case of the former shape memory resin, the repairing operation will be similar to that mentioned earlier. The repairing device is inserted until the repairing location is reached, power is fed from the power feeding device to allow the cylindrical cloth [7] to generate heat, the shape memory resin is heated to a temperature near the melting point in order to make it easy for it to expand in the diametrical direction, and liquid pressure is then fed into the expandable body [4] by means of a compressor to expand the expandable body [4] and to attach it tightly to the pinhole [15] location.

[Effects of the Present Invention]

In this manner, according to the device of the present invention, the expandable body itself heats up when energized, and therefore, the repairing sleeve can be heated directly and the repairing sleeve can be quickly softened efficiently and evenly regardless of the distance between the repairing location and the cutting inlet of the pipeline.

Moreover, since the expandable body can be heated while expanding the repairing sleeve in the diametrical direction, the degree of adhesion to the pipe's inner surface can be increased even more. Therefore, the repairing sleeve will not peel off after the adhesive is cured.

Next, since the main unit of the inserting tool for the repairing device is hollow, a repairing operation in an active pipe is possible.

4. Brief Explanation of the Drawings

Figure 1 is a vertical cross-sectional drawing of the repairing device pertaining to the present invention, Figure 2 is a cross-sectional drawing of the line a-a', Figure 3 is a vertical cross-sectional drawing of a condition in which the repairing device has been inserted until it has reached the repairing location, Figure 4 is a vertical cross-sectional drawing of a condition in which the repairing sleeve has been expanded in the diametrical direction by expanding the expandable body in order to attach it closely to the inner surface of the pipe, Figure 5 is a vertical cross-sectional drawing of the repairing location that shows the repair-complete condition, and Figure 6 is an explanatory drawing of a commonly known example.

[1] = inserting tool's main unit; [4] = expandable body; /199 [6] = liquid pressure injecting hole; [7] = cylindrical cloth; [16] = repairing sleeve.

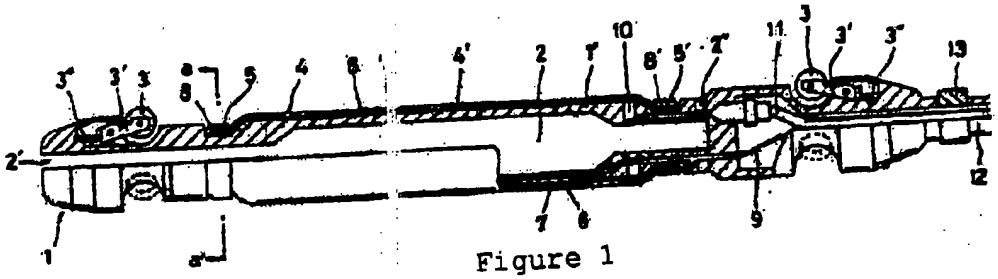


Figure 1

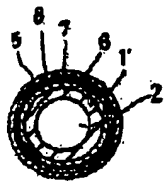


Figure 2

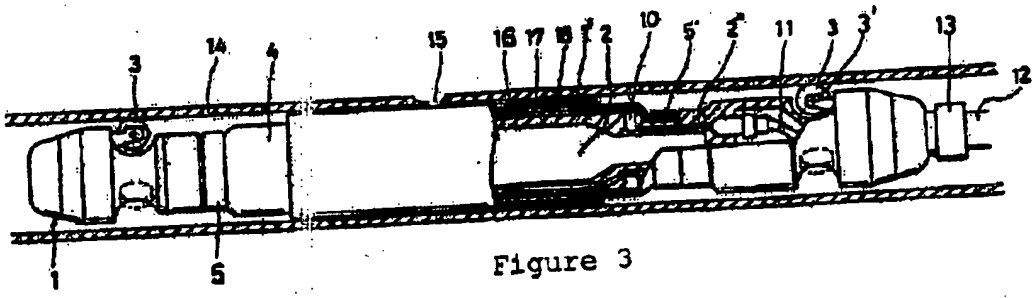
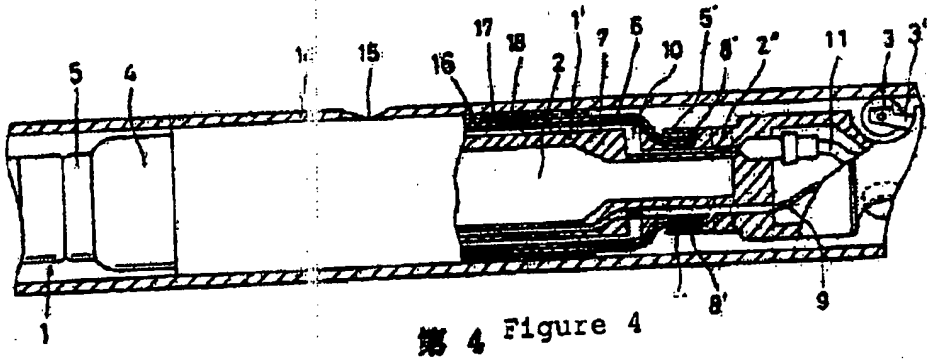


Figure 3



第 4 Figure 4

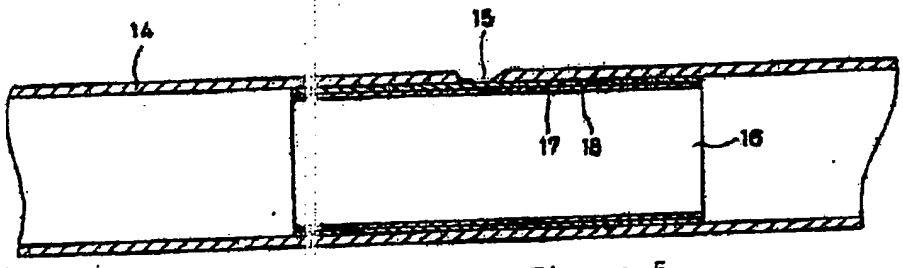


Figure 5

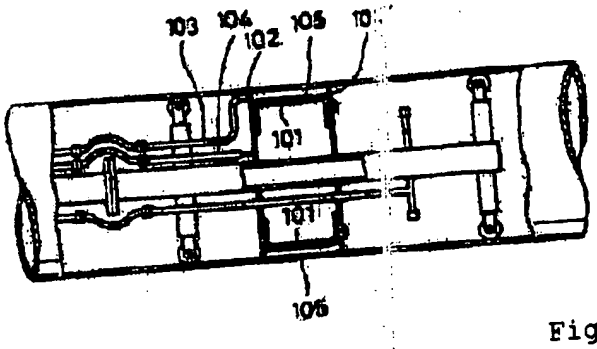


Figure 6

第 6 図

EXHIBIT F

Japan '161

"Lining Jig and Lining Method For Branch Pipe"

WEST

End of Result Set

Generate Collection Print

Japan 161

L1: Entry 2 of 2 File: DWPI Sep 4, 2000

DERWENT-ACC-NO: 1994-307386
DERWENT-WEEK: 200045

TITLE: Jig for lining branched pipes - has seal and expansion tubes heater and fluid supply connector

PATENT-ASSIGNEE:

ASSIGNEE	CODE
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YANAGISAWA T	YANAI

PRIORITY-DATA: 1993JP-0043382 (February 9, 1993)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 3084165 B2	September 4, 2000		006	B29C063/36
JP 06234161 A	August 23, 1994		005	B29C063/36

APPLICATION-DATA:

PUB-NO	APPL-DATE	APPL-NO	DESCRIPTOR
JP 3084165B2	February 9, 1993	1993JP-0043382	
JP 3084165B2		JP 6234161	Previous Publ.
JP 06234161A	February 9, 1993	1993JP-0043382	

INT-CL (IPC): B29C 63/28; B29C 63/36; B29K 101/10; B29L 23/00; B29L 23/22; F16L 1/00; F16L 55/16

ABSTRACTED-PUB-NO: JP 06234161A
BASIC-ABSTRACT:

Jig for lining branched pipes comprises a pliable and heat-resistant seal tube having an opening to adhere the back end of lining material, pliable and heat-resistant cylindrical expansion tube having a heater around its cylindrical part and fluid supply hose connector at its back end. A branched pipe is lined by adhering the back end of lining material at the opening of seal tube by using a low softening pt. adhesive, inserting them in the branched tube turning over the lining material, expanding the expansion tube by supplying compressed fluid to the expansion tube to tightly contact the lining material to the inner surface of branched pipe and heating the lining material by flowing an electric current to the heater to cure the thermosetting resin in the lining material.

USE/ADVANTAGE - To cure thermosetting resin in the lining material rapidly.

CHOSEN-DRAWING: Dwg.0/9

TITLE-TERMS: JIG LINING BRANCH PIPE SEAL EXPAND TUBE HEATER FLUID SUPPLY CONNECT

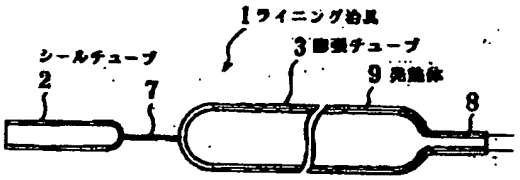
DERWENT-CLASS: A32 A88 Q67

Q

7　　8

21　本管　　22　取付管

【図1】



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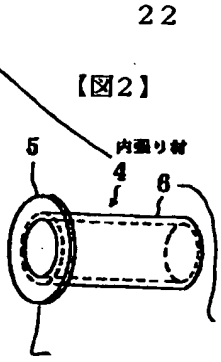

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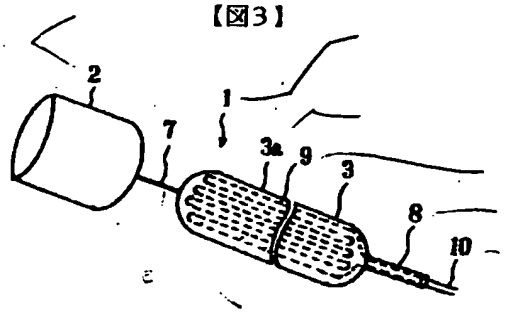

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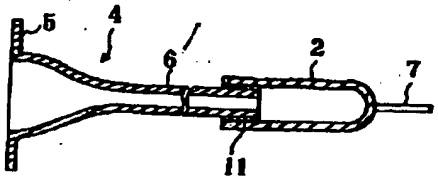

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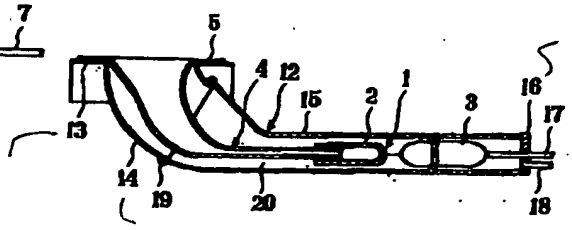
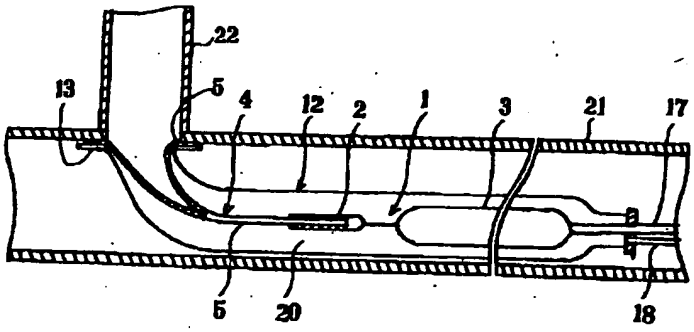
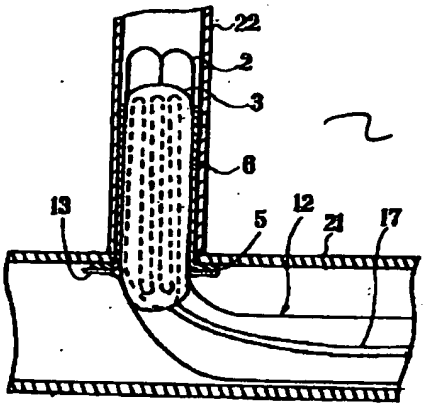


【図6】



【図8】



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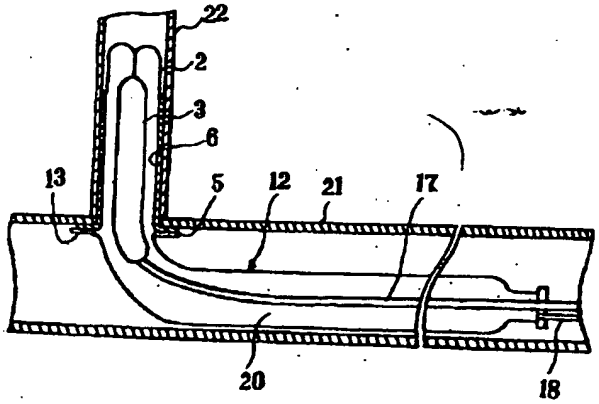

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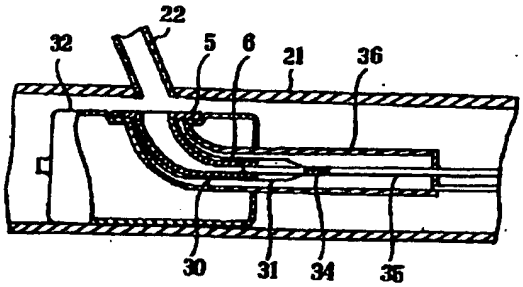

WEST

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L1: Entry 1 of 2 File: JPAB Aug 23, 1994

PUB-NO: JP406234161A
DOCUMENT-IDENTIFIER: JP 06234161 A
TITLE: LINING JIG AND LINING METHOD FOR BRANCH PIPE

PUBN-DATE: August 23, 1994

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APPL-NO: JP05043382
APPL-DATE: February 9, 1993

US-CL-CURRENT: 425/106
INT-CL (IPC): B29C 63/36; B29C 63/28; F16L 55/16

ABSTRACT:

PURPOSE: To improve the working efficiency by heat curing rapidly an inner lining material inverted into a branch pipe.

CONSTITUTION: A branc pipe lining jig 1 provided with a seal tube 2 and an expansion tube 3 with embedded heat developing body 9 connected with the rear end of the seal tube 2 is used. The rear end of the inner lining material 4 is connected with the opening of the seal tube 2 by a bonding agent of low softening point, and inverted and inserted into a branch pipe. The expansion tube 3 is expanded by a pressurized fluid and the inner lining material 4 is bonded with the inner face of the branch pipe. Power is applied to the heat developing body 9 in the expansion tube 3 to heat cure the thermosetting resin containing the inner lining material 4. After that, the lining jig is drawn out of the branch pipe.

* NOTICES * machine translation for Japan 6-234161

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The lining fixture for branch pipes characterized by providing the following. The seal tube with which it is flexible with tube, consists of a resin sheet which has thermal resistance, and has opening which pastes up the back end section of the lining material containing thermosetting resin with a flange on a point, and the back end section was sealed. The expansion tube with which it is formed in the shape of a cylinder by the resin which has elasticity and thermal resistance, and a point is sealed, and it connects with the back end section of the above-mentioned seal tube, and has the fluid supply hose connection section in the back end section, and the heating element taken about along with the longitudinal direction was embedded at the body.

[Claim 2] The back end section of lining material with a flange is pasted up on nose-of-cam opening of the seal tube of the above-mentioned lining fixture with the adhesives of low softening temperature. Lining material and a lining fixture are inserted into the attaching part of a lining work tool. Attach the flange of lining material in the attaching part upper surface, and a fluid supply hose and an electrical cable are connected to an expansion tube. The flange which sealed the back end section of an attaching part, moved the lining work tool to this pipe-connection section of a branch pipe, and was attached in the attaching part upper surface is pressed in this pipe-connection section. Supply a pressurization fluid in an attaching part, and lining material and a seal tube are reversed and inserted into a branch pipe. Eliminating the pressurization fluid in an attaching part, supply a pressurization fluid in an expansion tube from a fluid supply hose, and an expansion tube is expanded. The lining construction method characterized by pulling out a lining fixture after carrying out heat hardening of the thermosetting resin which is made to stick lining material to a branch pipe inside, energizes to the heating element in an expansion tube, and is included in lining material.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the lining fixture for branch pipes and the lining construction method of using it, when forming a plastic conduit in the branch pipe inside of established piping, such as a sewerage pipe, a water-works pipe, and a feed tube.
[0002]
[Description of the Prior Art] For example, the method of construction which lines synthetic resin is adopted as the side of a book of an established pipe for the purpose of on-the-strength reinforcement of established pipes, such as a sewerage pipe and a water-works pipe, the cure against corrosion prevention, leakage of water and the cure against invasion water, or a flow rate improvement. Invasion water enters most mostly from a part for the connection of the attachment pipe which branched for example, from the sewerage main. Various kinds of water cutoff methods of construction are adopted in order to prevent the invasion water from a portion with which a part for a connection and the attachment pipe itself of this attachment pipe broke, for example, as shown in JP,2-239920,A, JP,3-130130,A, etc.
[0003] In lining this pipe-connection section of this attachment pipe by synthetic resin, it is using the lining material 30 which consists of the felt flange 5 which contains thermosetting resin as shown in drawing 9 , a felt tube 6 fixed to the portion of the hole of the felt flange 5 including thermosetting resin, and an inner tube 31 which covered the felt tube 6. The flange 5 of this lining material 30 is fixed to the connection of the attachment pipe 22 of a main 21 by the packer 32 grade which consists of an elastic body of a saccate. Pressurization air etc. is supplied in the reversal guide pipe 36 from the fluid supply hose 35 which has a hole 34. a point -- fluid discharge -- After reversing and inserting the felt tube 6 into the attachment pipe 22, reversing an inner tube 31, The thermosetting resin which supplies heating pressurization fluids, such as warm water and a steam, from the fluid supply hose 35 inside the felt tube 6 which carried out reversal insertion, and is contained in the felt flange 5 and the felt tube 6 is stiffened. Then, the synthetic-resin layer of one is formed in this pipe-connection section of the attachment pipe 22, and the inside of the attachment pipe 22 by removing an inner tube 31.
[0004]
[Problem(s) to be Solved by the Invention] As mentioned above, although the thermosetting resin contained in the felt tube 6 which carried out reversal insertion into the attachment pipe 22, and the felt flange 5 was heated with the heat of heating fluids, such as warm water supplied from the fluid supply hose 35, and a steam, and is hardened conventionally, when repairing a duct by un-excavating, this pipe-connection section of the attachment pipe 22 is usually 20m or more away from the manhole or the work digging position. For this reason, the fluid supply hose 35\connected to heating fluid feeders, such as a boiler installed near [a manhole etc.], cannot but become long, and the fluid supply hose 35 cannot but supply a heating fluid, where the pars basilaris ossis occipitalis of the low main of temperature is contacted comparatively. For this reason, a heating fluid makes it cool, and when the pars inflexa of the felt tube 6 is reached, the temperature of a heating fluid will become low fairly. Especially, in the case of a sewerage pipe, it may construct in the state where water etc. is flowing within a book, and the

temperature reduction of the temperature of a heating fluid becomes more remarkable within. For this reason, when a steam was supplied, for example, the steam condensed in the middle of the fluid supply hose 35, and when the water of condensation piled up in the fluid supply hose 35 and it became impossible to have sent the steam to the pars inflexa of the felt tube 6, it was.
[0005] Moreover, **** cannot harden quickly the thermosetting resin contained in felt tube 6 grade by temperature fall even when warm water is supplied, but working hours start for a long time.
[0006] Although it is cancelable if the amount of the heating fluid which such demerits enlarge the bore of a fluid supply hose, and supply is made [many] and the rate of flow is raised, in order to supply a heating fluid, two hose, a fluid supply hose and a fluid recovery hose, are needed. For this reason, when the diameter of a hose was enlarged, there was demerit in which the handling when moving a felt tube etc. to this pipe-connection section was not easy, and working capacity fell too.
[0007] This invention is made in order to cancel this demerit, heat hardening of the lining material which carried out reversal insertion into the branch pipe is carried out quickly, and it aims at acquiring the lining fixture for branch pipes and the lining construction method of raising working capacity.
[0008]
[Means for Solving the Problem] The seal tube with which the lining fixture for branch pipes concerning this invention is flexible with tube, and consists of a resin sheet which has thermal resistance, it has opening which pastes up the back end section of the lining material containing thermosetting resin with a flange on a point, and the back end section was sealed, It is characterized by being formed in the shape of a cylinder by the resin which has elasticity and thermal resistance, sealing a point, connecting with the back end section of the above-mentioned seal tube, having the fluid supply hose connection section in the back end section, and having the expansion tube with which the heating element taken about along with the longitudinal direction was embedded at the body.
[0009] Moreover, the lining construction method concerning this invention pastes up the back end section of lining material with a flange on nose-of-cam opening of the seal tube of the above-mentioned lining fixture with the adhesives of low softening temperature. Lining material and a lining fixture are inserted into the attaching part of a lining work tool. Attach the flange of lining material in the attaching part upper surface, and a fluid supply hose and an electrical cable are connected to an expansion tube. The flange which sealed the back end section of an attaching part, moved the lining work tool to this pipe-connection section of a branch pipe, and was attached in the attaching part upper surface is pressed in this pipe-connection section. Supply a pressurization fluid in an attaching part, and lining material and a seal tube are reversed and inserted into a branch pipe. Eliminating the pressurization fluid in an attaching part, supply a pressurization fluid in an expansion tube from a fluid supply hose, and an expansion tube is expanded. After carrying out heat hardening of the thermosetting resin which is made to stick lining material to a branch pipe inside, energizes to the heating element in an expansion tube, and is included in lining material, it is characterized by pulling out a lining fixture.
[0010]
[Function] In this invention, a seal tube is connected to the back end section of lining material with a flange, the back end section of lining material is sealed, and reversal insertion of lining material and the seal tube is carried out into a branch pipe with a pressurization fluid. After carrying out reversal insertion of lining material and the seal tube into a branch pipe, a pressurization fluid is supplied from a fluid supply hose in the expansion tube drawn even in the inside of the lining material which was connected to the back end of a seal tube and carried out reversal insertion, an expansion tube is expanded, and lining material is stuck to a branch pipe inside by the pressure of the pressurization fluid added to an expansion tube. Heat hardening of the thermosetting resin which energizes to the heating element in this expansion tube that expanded, and is included in lining material is carried out, and a plastic conduit is formed in this pipe-connection section of a branch pipe, and a branch pipe.
[0011]
[Example] Drawing 1 is the cross section showing the lining fixture of one example of this invention. As shown in drawing 1 , the lining fixture 1 which lines a plastic conduit in the inside of the attachment pipe of a sewerage pipe has the seal tube 2 and the expansion tube 3. It consists of a resin [which coated

with silicon resin to textile fabrics, such as nylon fiber,] sheet which is flexible and has thermal resistance, the saccate in which a nose of cam carries out opening and by which the back end section was sealed is carried out, and the seal tube 2 pastes up and seals the back end section of the lining material 4 with a flange as shown in the perspective diagram of drawing 2 to the inside of opening at a nose of cam. The lining material 4 has the felt flange 5 and the felt tube 6. The felt flange 5 and the felt tube 6 consist of textiles and the nonwoven fabric of synthetic resin which sank in thermosetting resin, and the hole of the ellipse type of a size according to the aperture of this pipe-connection section of the attachment pipe to construct and the configuration is opened in the center of the felt flange 5. The felt tube 6 has 90 - 100% of outer diameter to the bore of an attachment pipe, the felt flange 5 is pasted by heating, or sewing junction of it is carried out.

[0012] It is formed by the resin which has elasticity and thermal resistance, for example, silicon resin, in the shape of a cylinder, a point is sealed, and the expansion tube 3 is connected with the back end section of the seal tube 2 with the engagement lobe 7. In the back end section of the expansion tube 3, it has the fluid supply hose connection section 8, and as shown in the perspective diagram of drawing 3, the heating element 9 taken about along with the longitudinal direction is embedded at middle body 3a. The lead wire 10 connected to this heating element 9 is pulled out from the fluid supply hose connection section 8.

[0013] Operation when next lining a plastic conduit in the inside of the attachment pipe of a sewerage pipe using the lining fixture 1 constituted as mentioned above is explained.

[0014] First, as shown in the perspective diagram of drawing 4, the back end outside side of the felt tube 6 of the lining material 4 and the inside of nose-of-cam opening of the seal tube 2 are pasted up with the low melting point adhesives of a rubber system. and the guide of the inscribed board 13 in the upper-limit section of the lining work tool 12 in which the lining material 4 and the lining fixture 1 were attached on the automatic run vehicle in the manhole as shown in the cross section of drawing 5 -- it inserts into a guide pipe 14 from a hole, and the felt flange 5 of the lining material 4 is arranged on the upper surface of the inscribed board 13 then, a lead-in of the water stop 16 attached in the back end section of the epicyst tube 15 attached in the back end section of a guide pipe 14 -- the fluid supply hose 17 which the electrical cable was made to meet from a hole is drawn, the lead wire 10 and the electrical cable which were pulled out from the expansion tube 3 of the lining fixture 1 are connected, and the fluid supply hose connection section 8 and the fluid supply hose 17 of the expansion tube 3 are connected Moreover, the point of the pressurization fluid supply hose 18 is also fixed to a water stop 16. And the point of the epicyst tube 15 is connected to the back end section of a guide pipe 14 by the fastener 19, and a pressure containing member 20 is sealed.

[0015] It is made to run the lining work tool 12 by the automatic run vehicle to the position of this port of the predetermined attachment pipe 21 in a main 21, and is made to position and stop in this state. Then, checking with a television camera etc., (un-illustrating) as shown in the cross section of drawing 6, the felt flange 5 of the inscribed board 13 upper surface of the lining work tool 12 is set by the position of this port.

[0016] If the alignment of the felt flange 4 is completed, the lining work tool 12 will be raised using the oil pressure sent from an automatic run vehicle, and the felt flange 5 of the inscribed board 13 upper surface will be pressed to main 21 inside of the circumference of this port.

[0017] Pressurization air is supplied to a pressure containing member 20 from the pressurization fluid supply hose 18 attached in the water stop 16 in this state. As shown in the cross section of drawing 7, into the attachment pipe 22, it is reversed, and the felt tube 6 of the lining material 4 and the seal tube 2 of the lining work tool 1 are inserted one by one, by the pressurization air supplied to this pressure containing member 20, and carry out a pressure welding to the inside of the attachment pipe 22 with it. The expansion tube 3 is drawn to the position inside the felt tube 6 by reversal insertion of this seal tube 2. If the seal tube 2 is reversed and inserts, the pressurization air supply to a pressure containing member 20 will be stopped, and the high pressurization water of a pressure will be supplied in the expansion tube 3 from the pressurization air supplied to the pressure containing member 20 from the fluid supply hose 17 connected to the expansion tube 3. Since the outside of the expansion tube 3 has pressurization air

which has compressibility when pressurization water is supplied in the expansion tube 3, the pressurization air of the outside of the expansion tube 3 is contracted with the pressure of pressurization water, and the expansion tube 3 starts expansion. And if the pressurization air in a pressure containing member 20 is discharged one by one from the pressurization fluid supply hose 18, the expansion tube 3 will expand gradually, and as shown in the cross section of drawing 8 , some of felt tube 6 whole of the lining material 4 and seal tubes 2 will be stuck to the inside of the attachment pipe 22. Since the heating element 9 built in when expanding this expansion tube 3 is surrounded along with the longitudinal direction of body 3a of the expansion tube 3, it can expand the expansion tube 3 for a heating element 9 to carry out nothing to resistance and a bird clapper.

[0018] Power is supplied to a heating element 9 in this state. A heating element 9 generates heat, shortly after power is supplied, it heats the felt tube 6 stuck to attachment pipe 22 inside, and the felt flange 5 stuck to the circumference of this port, carries out heat hardening of the thermosetting resin contained in the felt tube 6 and the felt flange 5, and forms the lining layer stuck to this pipe-connection section of the attachment pipe 22, and the inside of the attachment pipe 22. The low melting point adhesives 11 which connected the felt tube 6 and the seal tube 2 simultaneously are fused.

[0019] After the thermosetting resin which carries out predetermined-time supply of the power, and is contained in the heating element 9 at the felt tube 6 and the felt flange 5 carries out heat hardening, the power currently supplied to the heating element 9 is intercepted, the pressurization water supplied to the expansion tube 3 is discharged from the fluid supply hose 17, and the fluid supply hose 17 is pulled out outside. Since the joint of the felt tube 6 and the seal tube 2 touches the large attachment pipe 22 of heat capacity at the inside when pulling out this fluid supply hose 17 outside, the low melting point adhesives 11 are in the melting state, and can exfoliate the seal tube 3 easily from the felt tube 6. Then, the lining work tool 12 can be descended and the seal of attachment pipe 22 inside and the connection of a main 21 can be carried out by the synthetic resin which consists only of lining material 4 by separating from the felt flange 5 which hardened the inscribed board 13. Then, a manhole is run an automatic run vehicle and preparation of the next work is started.

[0020] In addition, although the case where pressurization air was supplied in a pressure containing member 20 was explained when the above-mentioned example carried out reversal insertion of the felt tube 6 into the attachment pipe 22 Incompressible pressurization water is supplied in a pressure containing member 20, and reversal insertion of the felt tube 6 is carried out, and when supplying pressurization water to the expansion tube 3 and expanding in it, you may make it discharge the pressurization water in a pressure containing member 20 synchronizing with supplying pressurization water in the expansion tube 3.

[0021]

[Effect of the Invention] Since this invention connects a seal tube to the back end section of lining material with a flange, seals the back end section of lining material and carries out reversal insertion of lining material and the seal tube into a branch pipe with a pressurization fluid as explained above, it can carry out reversal insertion of the lining material into a branch pipe easily.

[0022] After carrying out reversal insertion of this lining material and the seal tube into a branch pipe, lining material can be uniformly stuck to a branch pipe inside by the pressure of the pressurization fluid added to an expansion tube by supplying a pressurization fluid from a fluid supply hose in the expansion tube which was connected to the back end of a seal tube and was drawn even in the inside of the lining material which carried out reversal insertion, and expanding an expansion tube.

[0023] Moreover, by energizing to the heating element in the expansion tube which expanded, by heating lining material directly, heat hardening of the thermosetting resin contained in lining material can be carried out in a short time, and the construction time when forming a plastic conduit in this pipe-connection section of a branch pipe and a branch pipe can be shortened sharply.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the cross section showing the lining fixture of the example of this invention.
[Drawing 2] It is the perspective diagram showing lining material.
[Drawing 3] It is the perspective diagram showing the above-mentioned lining fixture.
[Drawing 4] It is the cross section showing the state where the lining fixture was attached in lining material.
[Drawing 5] It is the cross section showing the state where lining material and the lining fixture were attached in the lining work tool. [drawing 6
It is the cross section showing the state where the attachment pipe-connection section was run the lining work tool.
[Drawing 7] It is the cross section showing the state of reversal insertion of lining material.
[Drawing 8] It is the cross section showing the expansion state of an expansion tube.
[Drawing 9] It is the cross section showing the conventional example.
[Description of Notations]
1 Lining Fixture
2 Seal Tube
3 Expansion Tube
4 Lining Material
5 Felt Flange
6 Felt Tube
8 Fluid Supply Hose Connection Section
9 Heating Element
10 Lead Wire
12 Lining Work Tool
17 Fluid Supply Hose
18 Pressurization Fluid Supply Hose
21 Main
22 Attachment Pipe

[Translation done.]

EXHIBIT G

Japan '323

"A Heater Tube and Method For Repairing of Conduit"

Machine Translation Output
JP2-158323A

Note:

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(19)[Country of Issue]
Japanese Patent Office (JP)
(12)[Official Gazette Type]Open patent official report (A)
(11)[Publication No.]JP,2-158323,A
(43)[Date of Publication]June 18, (1990)

(54)[Title of the Invention] A Heater Tube and Method for Repairing of Conduit

(51)[The 5th edition of International Patent Classification]B29C 63/36, B32B ,1/08 ZB29K101:10,B29K105:08,B29L 23:22,[FL]B29C 63/36, // B32B 1/08,ZB29K101:10,B29K105:08,B29L 23:22
[Request for Examination]Requested
[Number of Pages]8
(21)[Filing Number]Japanese Patent Application No. 63-312916
(22)[Filing Date]December 13, Showa 63 (1988)
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(57)[Abstract]
Since this Official Gazette is based on the data submitted before electronic application, abstract is not recorded.

[What is claimed is:]
(1) A heater tube characterized by attaching two or more conductors with conductivity higher than the conductivity of a conductive flexible tubular material in its long direction.
(2) A method of repairing of conduit, characterized by inserting said heater tube according to claim 1 after inserting or at the same time of inserting a conduit

lining material impregnated with thermosetting resin in a resin absorbing material, said heater tube and said conduit lining material are pressed onto the inner surface of said conduit by liquid pressure, said conductors in said heater tube is energized, then said heater tube is removed from said conduit.

(Field of the Invention)
This invention relates to the heater tube used for the pipeline repair method of construction which lines to inner surface of a superannuation pipe and repairs this superannuation pipe, and this method of construction.

(The conventional technology)
It is already proposed in the sewer pipe laid underground in the earth, electricity, a gas pipe, the other conduits for industry, or the pipeline repair method of construction to which it lines to surface and repair, reinforcement, etc. carry out the superannuation pipe concerned, without digging these conduits when superannuated, and practical use is presented (for example, refer to JP,60-242038,A).
that is, this pipeline repair method of construction presses this to surface of superannuation while it makes it reversed in a superannuation pipe and inserts [inside] the pipe lining material which hardenability resin is made to sink into the flexible resin absorption material which carried out film coating of that surface, and grows into it by liquid pressure
Then, it is the method of construction which is made to harden the hardenability resin into which that warming etc. is carried out sank pipe lining material, with lines by forming a rigid lining pipe in the inner circumference of the superannuation pipe concerned.

(Object of the Invention)
By the way, when thermosetting resin was used as hardenability resin into which the above-mentioned pipe lining material used for this method of construction sinks, since this thermosetting resin was indirectly heated considering fluid, such as water and air, as a heat carrier, heating took great thermal energy and great time to it, and there was in operation efficiency and workability, or the problem of being bad.
Moreover, the big difference of temperature between the perimeter parts which touch especially the inner periphery which touches a heat carrier, and surface in a conduit in being thick, the thickness of pipe lining material, and when the worst, there was also a problem that a crack arose in this.
This invention was made in view of the above-mentioned problem, and is made into the purpose -- and it is in offering the heater tube which the thermosetting resin into which pipe lining material sank uniformly is heated [tube], and makes this harden
Moreover, this invention sets it as the purpose planning an improvement of operation efficiency and workability, a cost town, etc. or to offer the made pipeline repair method of construction by using the above-mentioned heater tube.

(Means for solving the problems)
This invention is characterized by having attached two or more conductors with conductivity higher than this tubular member in the length direction of the flexible tubular member which has conductivity, and constituting a heater tube that the above-mentioned purpose should be attained.
moreover, interpolating a heater tube according to claim 1 inside this pipe lining material, and/or an as this heater tube and pipe lining material to surface in a pipeline by liquid pressure, while inserting after inserting into a pipeline the pipe lining material which the pipeline repair method of construction concerning this invention makes thermosetting resin sink into resin absorption material, and changes -- the above of a heater tube -- it energizes to a conductor
Then, it is characterized by removing a heater tube out of a pipeline.

(Action)
As mentioned above, have pressed a heater tube and pipe lining material to surface in a pipeline by liquid pressure.
If it energizes to the conductor of a heater tube, since current will flow in the direction of a circumference of a tubular member from one conductor, and will result in the conductor of another side and it will generate heat in the tubular member as a resistance object -- a heater tube -- all circumferences and full length, the thermosetting resin into which the pipe lining material which generates heat uniformly and is located in the perimeter side of this sank -- heating -- this thermosetting resin -- an instant -- and you make it harden uniformly.
Then, if a heater tube is removed out of a pipeline, a crack or fault, such as being generated, will not generate surface in a pipeline in the pipe lining material which it was lined by the hardened pipe lining material, and the repair was well made, and was hardened.
In addition, the removed heater tube is made for the following pipeline repair work.
Moreover, since according to this invention it tries to energize to the conductor of a heater tube and this heater tube is made to generate heat, it can do [a lot of heat carriers for heating thermosetting resin, becoming unnecessary and attaining miniaturization of heating equipment, and energy saving, and can do lowering the cost.

(Examples of the invention)
The case of the operation of this invention is explained based on attached drawings below.
Those of the heater tube 1 which Fig. 1 requires for this invention with perspective illustration, and this heater tube 1 attach the copper wire 3 and 3 of two conductive high trees rather than this tubular member 2 in the length direction of the flexible tubular member 2 which has conductivity, it is constituted, and coating of the perimeter side of the tubular member 2 is carried out with the

films 4, such as high urethane of airtightness, watertightness, and electric insulation, a polyester elastomer, and silicone.
In addition, it is used in the nonwoven fabric which mixes a carbon fiber to the felt material made from polyester, and grows into it as a tubular member 2, for example.
Next, the repair work of a pipeline done using the above-mentioned heater tube 1 is based and explained in Fig. 2 or the 5th figure.
In addition, Fig. 4 is an IV-IV line sectional view of Fig. 3.
In order to repair branch conduit 6 which branches from main conduit 5 of illustration, as shown in Fig. 2, an elbow 9 is supported by the arm 8 attached in the point part of the career 7 installed in main conduit 5, and the pipe lining material 10 is made to insert in with the heater tube 1 in this elbow 9.
The heater tube 1 is located inside the pipe lining material 10, and these constitute the outside double layer inside.
In addition, the pipe lining material 10 makes thermosetting resin sink into felt material, such as polyester, and is constituted.
And the end of the above-mentioned heater tube 1 and the pipe lining material 10 -- turning over -- this -- the upper end periphery of the above-mentioned elbow 9 -- attaching -- the other ends of an elbow 9 -- the end of a tube 11 -- attaching -- the other ends of this tube 11 -- a disk-like lid -- it blockades by the member 12
This lid -- it is attached at the member 12 in the space S formed in a tube 11 in the pipe 13 for compression air supply which carries out a opening, J1 power, HI3, and the pressure adjustment valve 15, and connects with the pipe 13 in the hose 17 derived from the output side of the air compressor 16.
Moreover, two copper wire 3 and 3 derived from the heater tube 1 -- a lid -- a member 12 is penetrated, and it extends out of Space S, and connects with the power supply 18 installed on the ground
Moreover, the inside of the heater tube 1, thermo couple is embedded, the l temperature sensor 19 or the lied line 20 which it is laid underground and derived from this temperature sensor 19 is connected to the temperature controller 21 similarly installed on the ground, and this temperature controller 21 is electrically connected to the above-mentioned power supply 18.
In addition, as for a power supply 18, neither exchange nor a direct current interferes.
Pass a hose 17 and vibes 13 in the compression air breathed out since it Ž§ and the air compressor 16 is driven -- if it supplies in Space S, a heater tube and the pipe lining material 10 will receive the pressure of this compression air, and will be reversed and inserted into branch conduit 6.
If an end is carried out at the full length of branch conduit 6 as shown in the above-mentioned heater tube 1, and reversal of the pipe lining material 10, insertion or Fig. 3, a power supply 18 will be turned on as which maintains the internal pressure of Space S at a predetermined value], and it will energize to the copper wire 3 and 3 of the heater tube 1.
Then, it is in the state where the heater tube 1 and the pipe lining material 10 were pressed by inner surface of branch conduit 6.

Flow in the direction of a circumference of the tubular member 2 from one [current or] copper wire 3, and it results to the copper wire 3 of another side.
A resistance object -- carrying out -- the tubular member 2, all the circumferences, and full length of it generates heat uniformly and heats thermosetting resin or directly it was permeated by the pipe lining material 10 with this heat -- having -- an instant -- and in order to harden uniformly.
Well, it is advanced in pipeline repair work and inner surface of branch conduit 6 is lined by the hardened pipe lining material 10.
In addition, the temperature of the heater tube 1 is detected by the temperature sensor 19, controls the supply current of the temperature controller 21 or a power supply 18 based on this detected temperature, and keeps the temperature of the heater tube 1 constant.
in order [moreover,] to harden promptly the thermosetting resin into which the pipe lining material 10 sank as mentioned above -- this -- heat -- there is [generating in a crack or fault, such as being generated, after hardening at the pipe lining material 10, or] nothing by producing whether it is distorted or there being nothing
Furthermore, it is also can lower heating equipment, small, and the cost that becomes compact, and there is also little consumption energy, ends, and repair work takes, since a lot of [in order to heat thermosetting resin] heat carriers are not needed, if the heater tube 1 concerning this invention is used.
And after that, the heater tube 1 is removed out of pipe lining material l0, branch conduit 6 is lined by the hardened pipe lining material 10, and cutting removal , ;ê completes the unnecessary part of the pipe lining material 10 in repair of this, as shown in Fig. 5.
In addition, the removed heater tube 1 is used repeatedly.
Next, another pipeline repair method of construction constructed using the heater tube 1 is based and explained in Fig. 6 and the 7th figure.
In addition, in Fig. 6 and the 7th figure, the same mark is given to the same element as Fig. 2 or the 5th figure was shown, and the explanation about these is omitted hereafter.
In this repair method of construction, as shown in Fig. 6, pipe lining material lo only is first drawn in branch conduit 6, and this is attached in the fixed stand 22 installed on the ground through ropes 23 and 23.
Next, in good casing 24 supported in the center of the above-mentioned fixed stand 22 in the end part of the heater tube 1, through and its end are turned over and this is fixed at the lower end opening perimeter of casing 24.
In addition, the seal of the insertion portion to the casing 24 of the heater tube 1 is airtightly carried out with the valve 25.
If compression air is supplied in good casing 24 from the air compressor 16, the heater tube 1 will be reversed one after another in response to the pressure of this compression air.
And if an end is carried out at reversal of the heater tube 1, or the full length of branch conduit 6 as shown in Fig. 7, a power supply 18 will be energized to the

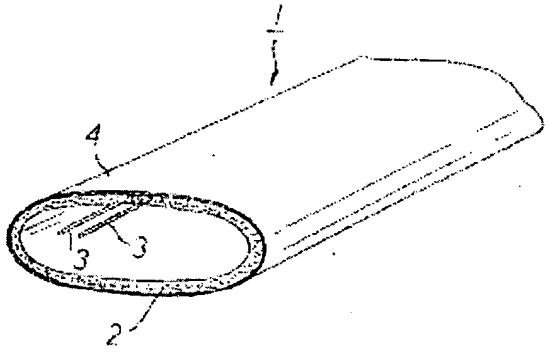
copper wire 3 and 3 of ONL / ,Ä heater tube 1 as which keeps constant the internal pressure of casing 24 and reversed heater tube 1 encircled space S.
Then, in order to heat the heater tube 1 or the thermosetting resin into which it generated heat uniformly and the pipe lining material 10 sank like the above-mentioned case of the operation and to make this harden promptly, having been obtained in the above-mentioned case of the operation is obtained in the same effect.
In addition, re-using-this heater tube if the rope 26 connected to the end of the reversed heater tube 1 is pulled and the heater tube 1 is removed out of the pipe lining material 10, after hardening, the pipe lining material 10 or.
A place d more than examples made reference about the case where especially the heater tube concerning this invention is used for repair of branch conduit, or, of course, this heater tube may be used also to repair of wood conduits.

(Effect of invention)
According to the description above, since this heater tube is made to generate heat by energizing to the conductor of a heater tube according to this invention, and the thermosetting resin into which pipe lining material sank with this heater tube is directly heated so that clearly, and it was made to make this harden promptly, it is obtained in the effect of aiming-at-operation efficiency of pipeline repair work, and workability improvement, cost cut, etc.

[Brief Description of the Drawings]
Fig. 1 is a perspective diagram of the heater tube concerning this invention.
Fig. 2 to Fig.5 are a sectional views showing the method of repairing of this invention.
Fig. 4 is an IV-IV line sectional view of Fig. 3.
Fig. 6 and Fig.7 are sectional views showing another case of the operation of this invention regarding the method of repairing.

1 .. Heater tube,
2 ... Tubular material,
3 ... Copper wire (conductor),
10 ... Conduit lining material,
16 .. Air compressor
18 ... Power supply.

第 1 図



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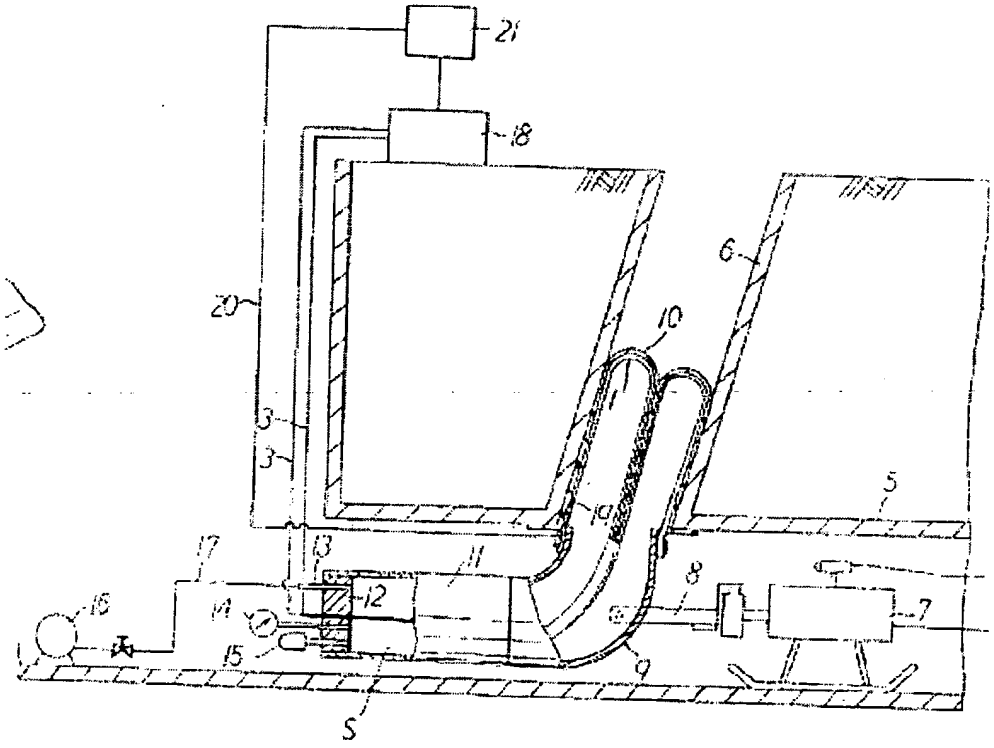

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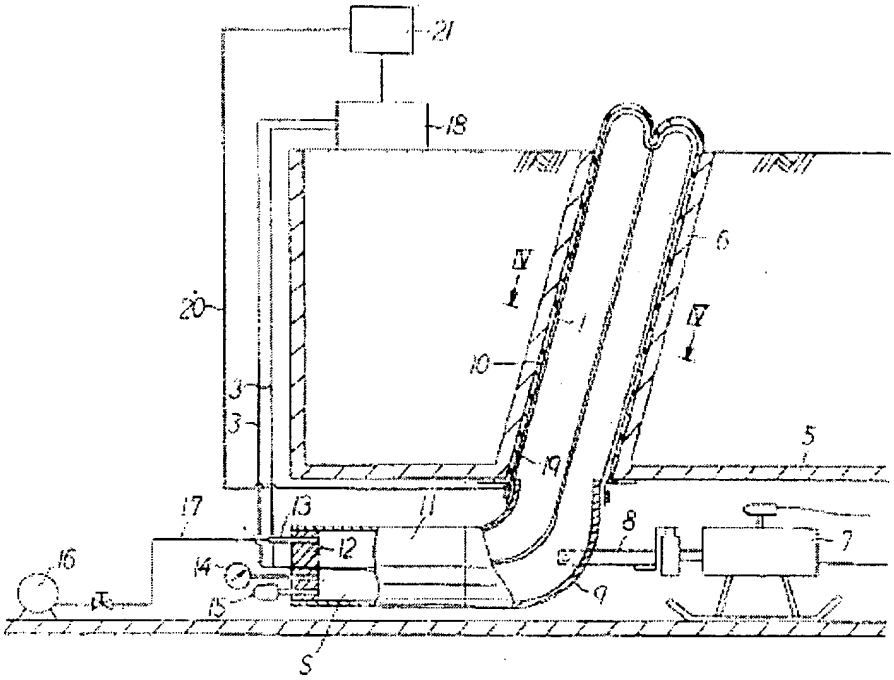

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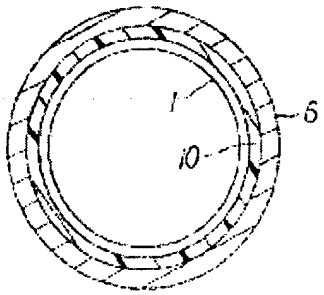

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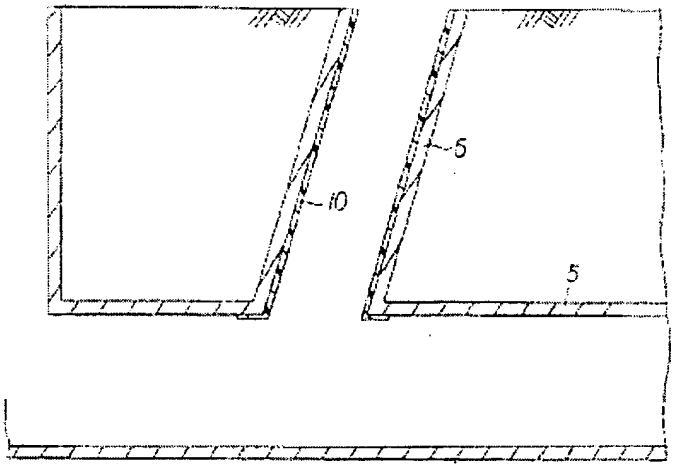
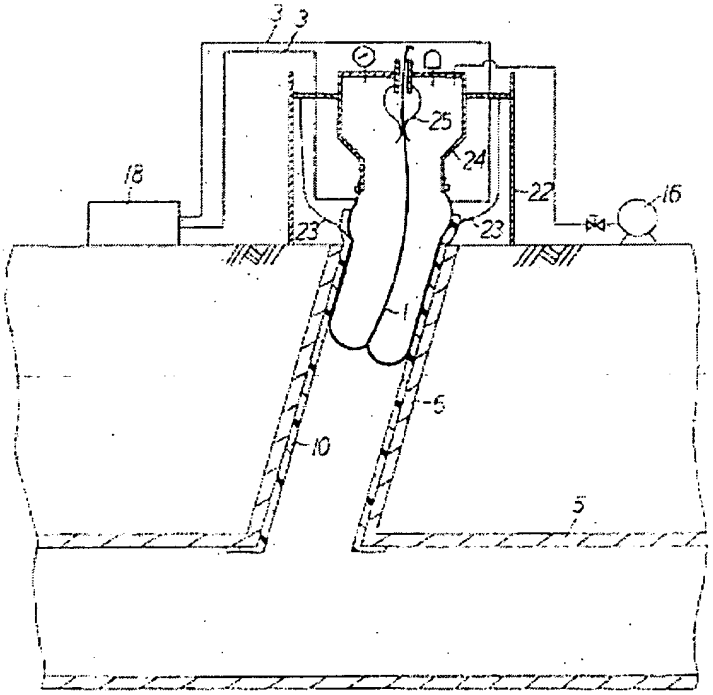


第6図



第 7 図

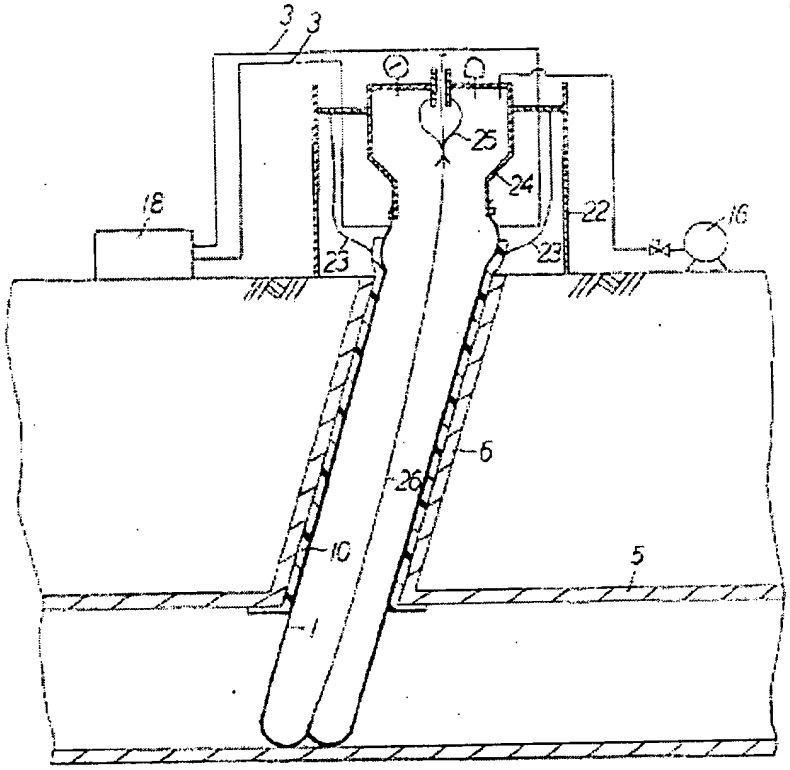


EXHIBIT H

Wood et al. 5,706,861

"Rehabilitation of Pipelines and Passageways with a Flexible Liner Using an Inflatible Bladder"